Designing a collaboration application for Sense Intellifield/Technology with use of Contextual Design

by

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Abstract

Sense Technology and its branch company Sense Intellifield delivers integrated automation and information systems for the oil industry, marine and other industries.
Now they are working on a project called IMEX, which is a communication system for the oil industry, to ensure better ways of communication between the offshore rigs and onshore support centers.

We used the method contextual design to get the needed data to design the prototype for our IMEX system. This method is based on going to the users' work place and observing them while they are working. The data obtained here is used to create work models, which is used to get a structured representation of the work practice. The models are redesigned to show the new proposed work practice, before we started to design the prototype. We had good experiences and results from using contextual design.

The results from contextual design were used as the basis for the prototype development. The first draft of the prototype was based on this together with the emphasis on keeping the existing design to make the system feel familiar. The draft was discussed with the development team at Sense and the feedback here was used to design the second draft.
We also had a discussion with Sense about the second draft before we went to test the prototype with the real users in the oil industry.

The prototype was well received from both the real users and the developers, with regards to usability and flexibility, and made a good basis for discussion for further work. It's not a complete solution, since this is a big system and to comprehensive to implement everything. The prototype is a suggested design with focus on four selected modules, which we found to be the most interesting.

Preface

This master thesis is written at Agder University College (AUC) in Grimstad, in collaboration with Sense Intellifield. The work has been carried out mostly at AUC, but also at Sense Intellifield in Kristiansand and at the Onshore Drilling Centre (ODC) at ConocoPhillips' Norwegian headquarters in Stavanger. The work period has been from December 2003 to May 2004.

We would like to thank our teaching supervisor, PhD research fellow at AUC, Bente Skattør and engineering manager at Sense Intellifield, Rune Skarbø, for great support throughout this period. We would also like to thank and developers at Sense Intellifield for support with the prototype testing and the ODC employees in Stavanger for good cooperation with the collecting of data for the design process.

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1.1. Sense Technology / Sense Intellifield

Sense Technology was founded in 1999 and is a supplier of integrated automation and information systems. Main customers are drilling and well contractors, as well as marine and other industry.

The remote operations branch has been split into a new company, named Sense Intellifield. This company has specialized in remote operations, and their solutions have provided cost reduction and productivity increase for their customers. One of their successful products is the Onshore Drilling Centre, from where onshore staff can monitor and support ongoing offshore operations.

1.2. Onshore Drilling Centre

The target of the Onshore Drilling Centre (ODC) is to give people onshore and offshore easier means of cooperation, and to enable a feeling of teamwork. The centre provides quality real time data from drilling, well and geo-disciplines and enables the right people to make real time decisions. Communications with the platform is achieved through a 100 Mbit/s fiber cable installed in 1999.

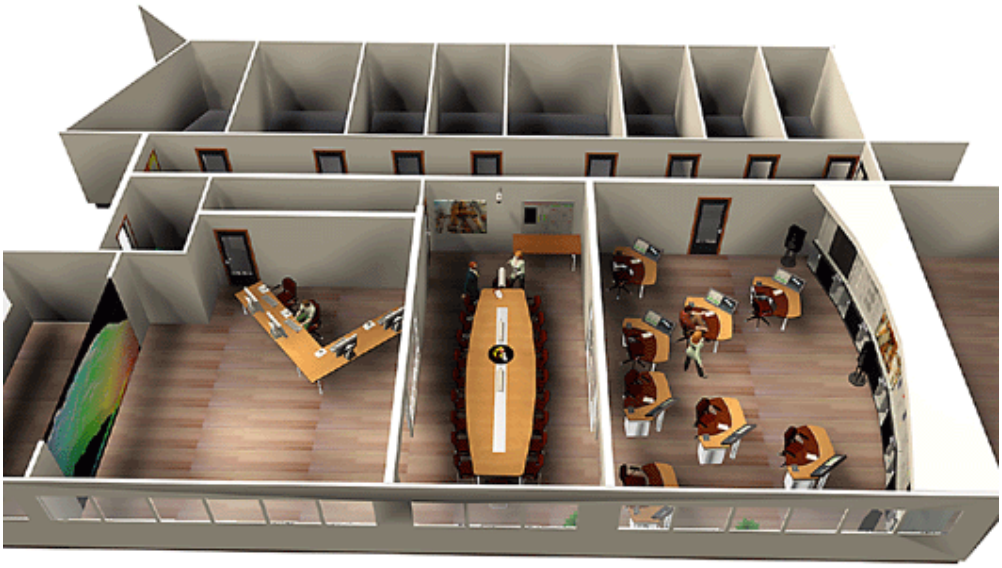

Figure 1- Typical Onshore Drilling Centre (ODC) layout

A general ODC from Sense consists of two or three rooms. The Operation Room contains several of Senses V-COM operator stations and a large visualization wall where data can be shared among people in the room. The operation room has access to live CCTV pictures and UHF rig radio and can follow the daily operation of the rig from onshore.

The Collaboration Room can be used for conferences, presentations and meetings. The room contains a visualization wall and cameras for video conferences, as well as projectors, document cameras and other multimedia equipment.

The Visualization Room contains a 3D display wall mainly used for well planning.

With the existence of the ODC it is possible to achieve significant cost reduction by moving some of the offshore personnel onshore. This also makes ODC personnel able to support more than one offshore operation at a time.

The ODC cost 30 million NOK to complete, but improvements and changes in collaboration routines facilitated great savings and led to a payback time of only 7 months. After 10 months of operation the centre had saved ConocoPhillips more than 60 million NOK.

The first ODC was completed at the ConocoPhillips Norway office in Risavik, Stavanger in November 2002, and the Eldfisk 2/7-A platform was the first connected platform in January 2003.

1.3. The IMEX project

With the good feedback from users of their operation centers, Sense Intellifield are now looking for new projects to enhance collaboration between users in remote operations. An ambitious project is under development during the spring and summer of 2004. The project has been named IMEX – Integrated Media EXchange.

According to an internal development document at Sense Intellifield, the goal of the project is to make "an interactive, multi user system that enables integration, total overview, simple selection and distribution of high quality images, video, audio and communication between multiple sites, in a multi-user environment."

The IMEX application will function well with already existing equipment from Sense, but must also be useable on other interfaces. The operation desks in the ODC will be most suited, but standard desktop computers and handheld devices will also be compatible.

Figure 2 - Visualization Control Module (V-COM)

For their ODCs Sense has designed a Visualization Control Module (V-COM) that is tailor made for use with a collaboration application. In front of the operator is a display unit with three integrated LCD screens, as well as a small camera used for personal video conferencing. The V-COM also includes a Console Touch Pad that can adjust the desk and display parameters, as well as the rooms lighting and temperature. The latter features will not be necessary on other interfaces.

1.4. Thesis Definition

Sense Technology is a supplier of integrated automation and information systems to the worldwide community of drilling and well contractors, marine and other industry. The company manufactures a wide range of products, from single control systems for machinery to advanced integrated screen based automation systems.

This project will define the user interface of a new application that is tailor made for communication between users that operate and offshore drilling rigs and onshore support staff.

By carrying out an ethnographical study with an approach based on Contextual Design - information about the context of use will be gathered, e.g. the work processes, how users communicate, how they collaborate and other issues. Also, many of the findings will be documented according to Contextual Design.

The understanding of the context of use, will provide critical and essential guidance when design the interface for the application. The aim is to design one or more modules, either as a prototype or as storyboards. The evaluation and the usability testing of the prototype will be performed together with users. The testing will be tailored for the context of use, and likely, some part will be based on well-documented methods and other parts will come from recent work.

We decided to use the following as a title for the thesis:

"Designing a collaboration application for Sense Intellifield/Technology with use of Contextual Design"

2. Contextual Design

2.1. Method overview

Contextual design is a development method that's centered on the customers. It includes techniques for studying how people work and discovering new data for redesigning an optimal work process. It's optimized for large and complex projects, but have been used with success for smaller projects as well.

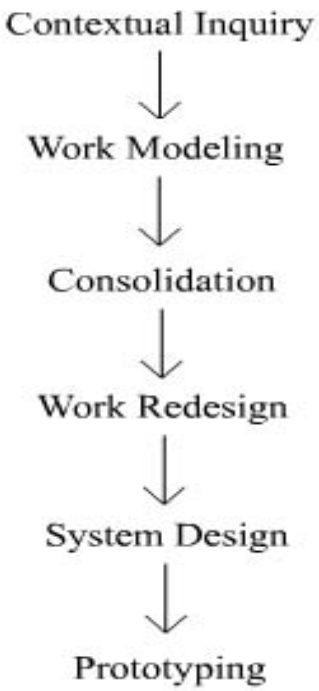

Figure 3 – The six steps of Contextual Design

We will go through each step, starting with a presentation of the method. Then we will look into our experiences with use of the method, and then present the results we got from using it. We will start with an overview over the six steps and then go deeper into detail on each of them.

2.1.1. Contextual Inquiry

The first step in the design process is understanding of the customers, find out how they work and what their needs are. This is done by observing and interviewing the customers while they work.

2.1.2. Work Modeling

After interviewing and observing the customer you have to use all that data you have gather in a sensible way. This is done by making work models to provide a concrete representation of how they work. There are five types of work models that we will have a closer look at later.

2.1.3. Consolidation

Since systems seldom is designed for one single customer, it's important to gather data from more than one source. Here you compare the data from the different customers and try to get a single picture of the customer population this system is being design for. To accomplish this you use an affinity diagram.

2.1.4. Work Redesign

The consolidated data is then used in this fourth step to drive conversations about how the work process can be improved and what technology can be used to accomplish this.
The focus here is set on inventing structured ways to improving the work process.

2.1.5. System Design

This step is finding the right function and structure to support the system work model from step four. These are usually hidden behind user interfaces and implementations in the system. This step helps to make the customers work continues.

2.1.6. Prototyping

The last step is testing out your prototypes with the customers. These are rough prototypes of system design and user interface ideas. In these sessions designers and users redesign these prototypes to best fit the users work process.

2.2. Contextual Inquiry

2.2.1. Method

This field interviewing method was designed with regards to how to get data about the work process so the designers can understand it. It studies individuals in depth to get a better understanding of the work they do on a daily basis.

The master/apprentice model

This model is used to describe the relationship between the customer and the designer as an effective way to collect data. The relationship between a master craftsman and his apprentice is something people are familiar with and know how to act out. This creates the right behavior on both sides. The principal here is teaching by doing and this way the craftsman doesn't need to be a teacher which he's not qualified to.

The apprentice can then ask questions while he works without preventing him from doing his work. Even if the craftsman was a good teacher he isn't aware of all the details in his work and the apprentice can pick up on these as he observes the work being done. The apprentice can then get several views on how to do different tasks and form his own opinion how to perform these tasks.

The four principles of contextual inquiry:

Context

The principle of context tells us to go to the customer's workplace and see the work as it unfolds (Whiteside and Wixon 1988). This is the basic concept of contextual inquiry. The idea here is to get as close as possible to the ideal situation which is being present. This provides us with ongoing experience rather than summary experience and concrete data rather than abstract data.

If you ask people what they think about a new system, they will summarize and give you some highlight of what they think. Usually a couple of things which they thought were really good or really bad. They would probably struggle to tell you why this was, because that would require them to go into details about their work. While observing the person working with this system instead, you will see a much greater level of detail.

This will further lead to getting real experience rather than abstract. People tend to put together a series of similar events rather than going in depth on one single event's specifics. If designers work from abstractions rather than real experience then chances are that the system will not be useful to people.

The key to getting good data is observing the work where it happens. This keeps the customers work concrete and prevents him from summarizing. Keeping to the master/apprentice model will help contribute to this.

Partnership

Partnership is used to make you and the customer cooperate to understand his work. Since the customer is the only one that truly knows the details about his work its important to let him show these. Partnership is preferred over the usual interview situation because an interviewer tends to control the communication to much. He will control what's asked and discussed and keep the customer from revealing the important details.

The master/apprentice model ensures that the power lies with the master/customer. But keeping strictly to this model limits the interviewer to much. An interviewer has different motives then an apprentice while observing work. Interviewers want data that helps them design a system that supports the work rather than learning how the work is done.

The designers have to understand the work structure and see patterns and distinctions in how the work is organized. This is why they have to try and create a partnership with the customer, and try to make him aware of aspects of his work that may be so natural to him that they have become "invisible".

Its important to keep to this partnership model and don't fall into other roles during the observation period. You want to avoid falling into the traditional interviewer role and end up controlling the communication. Two other relationship models you want to avoid is the expert/novice and the guest/host model.

When you come to observe a customer do his work on a system you have designed, it may be easy for him to look at you as the expert and start asking you questions. This keeps him from doing his work like he normally would and is of course not desired. You also want to avoid the taking the guest role. Being to polite and make the customer feel he has to attend to your needs will also prevent him from doing his work.

Interpretation

Observing the customer and bringing these observations back is one thing. The data or facts about the work alone aren't enough to make a good design. It's the interpretation of these facts that will enable you to make a good design. These interpretations lead to the good design ideas.

But if the design depends on these interpretations then we need a way to ensure that these are correct. The only way to do this is sharing them with the customer. This is a very important step in the procedure, if we don't share and validate our interpretations we defeat the entire purpose of working with the customer.

Going one step back in the process with bringing these interpretations back to the customer will ensure us that the understanding of the work is correct. The customer will then respond to the interpretations and help you fine tune the data. They usually make slight changes that give more precise data.

Focus

When interviewing a customer the interviewer need to know what aspects to look for, you need to set a focus for your questions. Focus gives a way to keep the conversation on topics that are relevant for the design. It's necessary to step a little out of the master/apprentice model because the master will only talk about topics he finds relevant and important.

Focus will reveal details in the areas you look into, but then again it will conceal detail in other areas. This makes it important that different interviewers have different focus for getting a wider collection of data relevant to the design. This ensures that people will see different things and the design team together will cover greater areas of the work in greater detail.

To expand their entering focus during the interview, the interviewer use intrapersonal triggers. These triggers are "inner flags" that's tells the interviewer that there is a chance to expand the interviews focus, these are the interviewers own feelings that tells him or her what's happening to the interview and how to act to fix it.

Some triggers to watch out for are:

Surprises and contradictions: This means that the customer says or does something you know is wrong or just for no specific reason. Instead of letting this go, you assume that nothing is done without reason, just like an apprentice would do.

Nods: This is the opposite, the customer do something exactly like you expected and you nod. To be sure you're making a safe assumption you should act like this is all new to you just like an apprentice would do.

What you don't know: The customer says or does something that you don't understand, this means you have to make the customer go back and describe this step by step, because if he doesn't it might lead to that you don't understand the following topics either.

2.2.2. Experiences

In our case contextual inquiry was a good way to study the work process and collect data in the ODC in Stavanger. The method is very well suited to do field work and the different approaches we tried to collect information all worked well. The combination of the master/apprentice model and partnership was very effective and provided us with a lot of data to further work. We got to follow two shifts over two days and talk to eight people working daily in the ODC, and also some of the management people.

The principle of context applied very well here, the ODC is a big and complex issue and it is necessary to have actually been there and see how the daily work unfolds. If we just had conducted the normal type of interviews we would have missed a lot of detail and defiantly not gotten the same understanding of the work process there.

It depends very on the person you are observing, whether or not you need to step out of master/apprentice model a lot. This we experienced with the people we were observing, some of them were very talkative and explained in great detail everything they did even if you did

not ask about it. While others just continued doing their work like there was nobody watching them and it was necessary to ask more questions.

Before going to Stavanger we had set focus on getting ideas for the framework and CCTV part of our coming prototype. Here we learned that it was not so easy to keep this focus as there was a lot of other issues together with these that the ODC engineer pointed out. Here we had to step a little out of the master/apprentice roles and into the partnership roles to get all the wanted information.

In fact our focus changed a bit during this trip, as we discovered some more areas that we wanted to include into our prototype. These were desktop sharing both for person to person and for the display wall, the use of video conferences and the issues that are included under room control based on the physical discoveries.

All in all we have to say that we got very positive results from using contextual inquiry, it's a well working method that proved to be quite flexible and very effective. Flexible in the sense that you can take different roles depending on the situation and effective because you personally get to observe the work process and therefore have the chance to get first hand information.

2.2.3. Results

The results here is what we discovered from our visits in the ODC in Stavanger with ConocoPhillips, with emphasis on the second trip where we spent two days together with the ODC engineers. From observing and talking to different people there, we used contextual inquiry to collect data for the next steps of contextual design.

The first visit we had at ConocoPhillips was early in the project period and was more or less a guided tour to get familiar with the ODC. Here we got to meet with representatives from Sense who spends much time in Stavanger and from ConocoPhillips, in addition to a tour around the facilities to see the center. On the second tour we started to work accordingly to contextual design and we will here document the most important findings.

CCTV

Today they have one CCTV camera operative from each rig. There are a lot of cameras installed around on the rigs, but they can only use one as of today. There are a lot of issues around surveillance and privacy when it comes to take more of the cameras in use.
People do not like to feel monitored everywhere they go and it is the same with the drilling crews.

Today they have one camera from each rig showing the drilling deck, which several people said was the most important camera when you had to choose one. There was one other camera that was specifically mention when it came to the possibility of getting more active ones, one that would be placed in the "shaker room", which is the place where "drilling liquids"/mud come up. The camera in the shaker room would save a lot of phone calls.

Another wish was the possibility to control the CCTV cameras from there own desk and the possibility to move them around/rotate them. Then be able to show this camera to on other desks in the ODC. Regarding the CCTV cameras, these are controlled by a PC that is out on

the drilling deck together with the camera. So if they need to reboot the camera they have to get out on deck to do this. The suggested solution here is to move this PC into the drilling leader's office or allow the ODC people to control it from onshore.

Desktop Sharing

The display wall is another big issue, like the CCTV situation today it is has a bit limited use. They use one screen to put up the three CCTV cameras from the three platforms which they are monitoring, besides that they have one screen each which they usually put up a drilling application on. This was the setup for most of the day, once something was put up there, they rarely changed it.

The possibility to have more than one screen from each desk up on the big screens was something that fast came up. If they have to monitor more than one rig, and then it really would not be enough with one screen from each desk. But this was something they opposed as it would be to much to keep track of two rigs. There should not be a problem to have more screens from one desk up on the wall, the only issue here is will it be possible to read what the screen says if you for example put four of them up on the same big screen. The reason here being that the drilling deck camera is all they really have access to today, without specifically

The sharing of information do not have to go through the display wall, it should be possible to share screens directly with another person both in the operation room and outside it. This will bring up issues around who should be able to share information, especially to people outside the organization. Since exactly that is a very important issue, it is needed to work out a solution here.

.**Video Conferences**

Video conferences were a thing they had taken in use a lot, they had one with the drilling crew from each rig every morning and in the evening or in other situations if needed. These conferences took place from 08.00 – 09.00 in the morning with approximately 20 minutes spent on each. They had a standard procedure with status reports on security, operations, personnel and equipment as the categories.

However, even if every desk in the ODC had a webcam installed, personal video conferences were a thing they did not use. This was something the wanted, but here again the network/software issues interfere. Since they got no supporting software at the moment they would have to use a program like Netmeeting, which is a program used to set up personal video conferences. This is something that could be made a lot easier with a IM – solution, there exists examples like today's different chat clients today like MSN and yahoo messenger that has this technology.

The Physical Aspect

We got a lot of input on the physical environment, which probably is quite natural. The first things you notice about your working environment would be the physical aspect of it. Like the layout of the office and the equipment within it and the ODC engineers seemed to had put a lot of thought into this.

First of all there were a lot of issues with the desk itself, the design and shape of it. The edge on the one side of the desk is rather "sharp" and one employee complained about hitting herself on it constantly. In general they felt that the desk could be improved both in functionality and flexibility.

The desk has little room for storing stuff and the ODC people have little room to move around on the desk. This is because they have 2 PC at each desk but only one of them fit into the cabinet intended to store them. So they need to have one standing under the desk outside the cabinet. The little touchpad computer that is placed above this cabinet is designed to big and is seldom used, so this could have been done through software instead. In theory you could have the exact same design and just use the mouse instead to control it.

Noise is another big issue. As one of the employees told that the air condition is installed without any isolation behind the wall of big screens to prevent overheating of the equipment. This proved to have some drawbacks, not only does this create a lot of noise which makes it hard to stay fully concentrated over long shifts, but it made the big screens actually shake loosen from the wall.

The lighting situation also got a lot of issues connected to it. First of all the lights were installed to spread out into the room, this proved to be a bad choice since this lead to reflections in the big screens up on the wall. Because of this they had taken down the first section of lights that pointed towards these screens. It would have been better to have lights that were directed straight down towards the floor. There were some spotlights on one side of the ODC, which did not have much of a function there; these could have been placed in the front of the screens as supporting lighting there instead.

2.3. Work Modelling

2.3.1. Method

The data collected from the contextual inquiry process are used to create work models, which is the next step in this method. This work models are used as a graphical language to get a deeper understanding of the work structure. These models show what data each interviewer has collected and become a tool for further development.

Now the whole design team can look at the models and have discussions about the content. You can also take these models back to the customer to ensure that the understanding you have of their work is correct.

There are five types of work models, each with different concepts and representing different work aspects.

The Flow Model

Flow models are built to represent the communication and coordination necessary to perform the work. This model shows how work is divided among different people and how they work together to get the whole job done. The idea id to create a bird's eye view of the organization

The key points of this model are:

- Communication
- Coordination
- Strategy
- Roles

The Sequence Model

This model is based on the steps that unfold in the work over time. When you look at it over time it becomes a sequence of actions or steps which lead from one to another. The goal here is changing or removing steps to make the work more efficient and reveal the detailed structure of it.

Key elements:

- Steps
- Hesitations and error
- Triggers
- Intents

The Artifact Model

Artifacts are everything people create, use or modify while doing their work. You can compare these to archaeological findings; they all have some history attached to them. "An

artifact model is a drawing or photocopy of the artifact, complete with any handwritten notes. The model extends the information on the artifact to show structure, strategy and intent"(s.103).

Key elements:

- Structure
- Information content
- Informal notes
- Presentation

The Cultural Model

Every workplace has its own culture, so understanding this is important when designing a system for these workers. The system needs to fit into the cultural context to be successful, with cultural context being invisible but very essential for everyone working there. This model concretizes the influences that exist within a workplace.

Key elements:

- Tone
- Policies
- Organizational influence

The Physical Model

The workplace is a physical environment; this environment either makes the work easier or harder. This environment includes all products or systems that people use in this place together with rooms and buildings. Studying how people restructure their workplace gives you ideas about what environment they prefer to work in. The physical model shows how the physical environment affects work.

Key elements:

- Organization of space
- Division of space
- Grouping of people
- Organization of workplaces
- Movement

2.3.2. Experiences

The first thing we did here was to evaluate which models we wanted to use further into the process. We decided that the flow model, sequence model and the physical model were the best suited ones in our case and would have the most impact on the upcoming prototype.

Type of model	Used	Not Used
Flow Model	X	
Sequence Model	X	
Artifact Model		X
Cultural Model		X
Physical Model	X	

Figure 4 – Model decision table

We decided to go with those three models, since those would be most relevant in this case and have the most impact on the prototype design, and this would give us more time to focus on the prototyping.

The artifact model was also not suitable in our case. The ODC engineers is equipped with custom made desk and work place, like the operation room, where everyone work with standard equipment. This means each desk has the same tools that they need to carry out their work and the use of artifacts is minimal to non excitant.

We found the flow model to be well suited to get a better picture of how the work is organized. It proved a good way to structure communication, coordination and the roles around the daily work in the operation room and the use of the collaboration room. So this model fit our case very good.

The sequence model also proved to fit our case, there was certain routines in the daily work which this model was very well suited to describe. The model describes step by step the actions that are taken when for example an ODC notices that something is not like it is supposed to in the drilling process on the rig that he or she monitors. To map up these steps is a great way to spot possible improvement and make that certain process even easier to carry out.

The physical model was the one which we got the most feedback on, as the ODC engineers had a lot of input here. This model is probably suitable everywhere you go, there will always be issues around the physical environment at any work places. In this case all the feedback comes as a result of the centre being the first of its kind and it would be strange if they got everything to run smooth on the first try.

We had a very positive experience with drawing up the model and bringing them to the actual users in the ODC. This proved to be very effective to get as accurate models as possible. They responded very well to this approach and were very helpful with getting this as correct as possible, so the method proved to be very strong here.

2.3.3. Results

From the data we collected through contextual inquiry, we have drawn flow models, sequence models and physical models. These represent different views of representing the gathered data. This is done by working together with the actual users. You draw the models and then you go back to the users so they can look over them, and give corrections and improve them. This can be done multiple times if needed, to get the models as accurate as possible.

Flow models

The flow models represent the communication and coordination of the organization. In this case we have chosen to draw flow models of the ODC and the people that play a role in running the ODC (figure 1). This first model show the different roles the people involved with running the operation room have, this is the part of the ODC that has people working there 24/7.

The model is centered around these workers, which we have called ODC engineers. These engineers are divided into two, those who are monitoring everything that happens on the surface and those who are monitoring everything down in the wells. These two groups have one boss each, an operation leader, who is in charge of each engineer group. Then those two have one boss that is the head of all these engineers. This person we have chosen to leave out the model since he clearly did not have much to do with the daily operation, none of the engineers even knew who he was. All these people are consultants and are hired in by ConocoPhillips to handle the daily work of the ODC.

Together with the engineers, we have a representative from the company that handles the drilling and runs the rigs, that is placed in the operation room. His role there is to be a technical consultant and a link between the drilling crew and ODC engineers. This is to make the two companies cooperate easier.

The ODC engineers are of course directly connected with the drilling crew through the UHF radio and by phone; this is where most of the interaction takes place. The engineers have responsibility to assist one rig each and work together with the derrick man and driller/drilling leader on that rig. These are the roles that are filled 24 hours a day, 7 days a week.

These are the main people directly connected to the daily work in the operation room. Beside from the roles, the only other role we have drawn in this model is one where we have put all the office personnel around the ODC. These people drop by the operation room when they

have to check up on what is going on out on the rigs or when they need some parameters to do calculations.

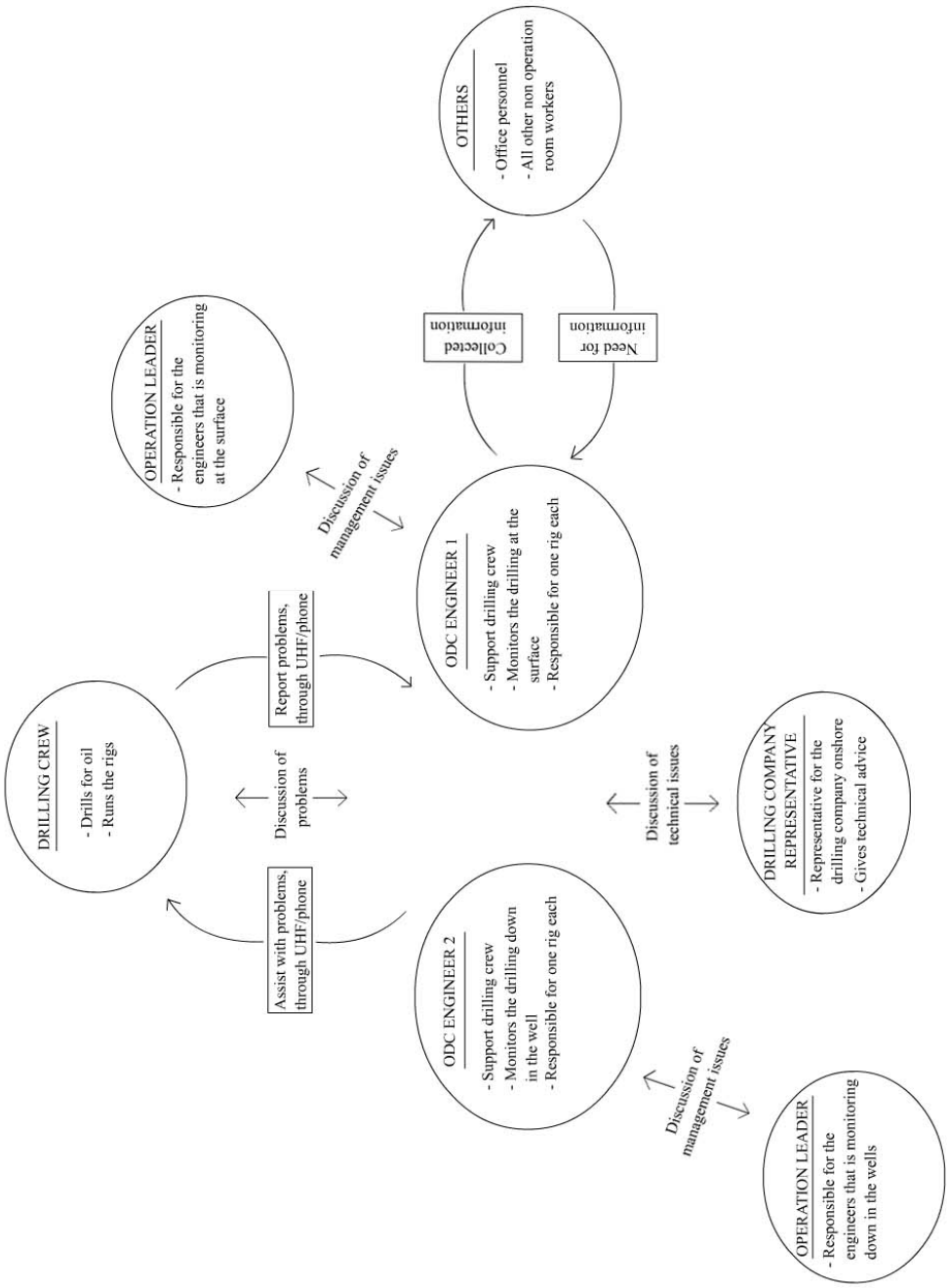

Figure 5 – Organizational overview flow model

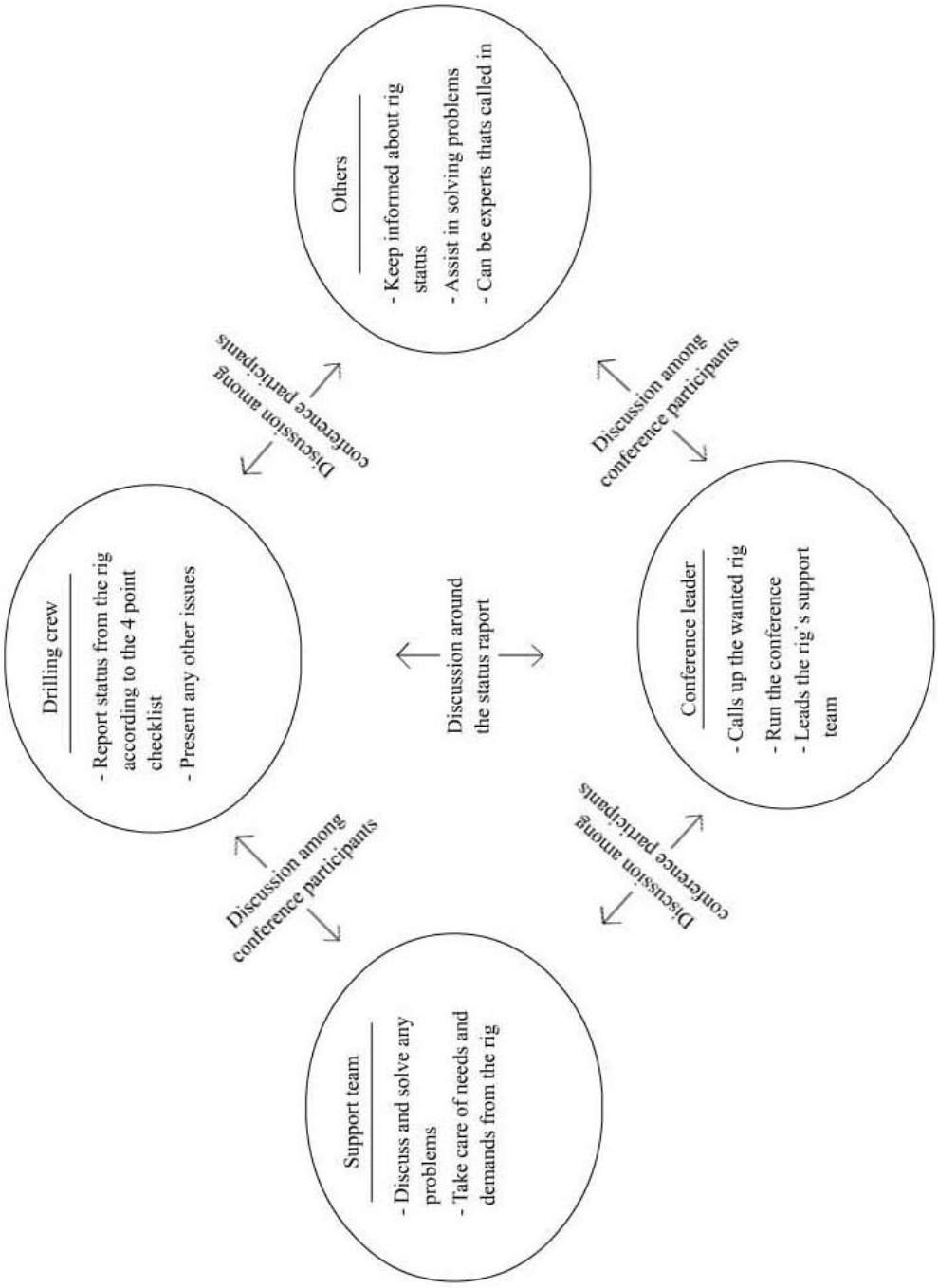

Figure 6 – Video conferencing flow model

The second model represents the daily video conferences which take place between the rigs and support teams onshore. These conferences follow a specific pattern each time in the sense that the drilling crew from each rig reports back to their support team according to a four point list. So these conferences are quite standardized to get an effective status update twice a day, with one conference in the morning and another one in the evening.

The conferences are usually run by one person, who is represented on the model (figure 2) as conference leader, he calls up the rig and leads the conversation. He takes the drilling crew through the different points on the list and together with the rest of the people connected to that rig, which are represented in the model as the support team; they handle all request and demands from the rig.

There is also discussion around possible drilling issues; this takes place between everyone that participates in the conference. This means also everybody else that is present under the conference; these are represented by the last role, which we have called others. This can be people from other support teams or somebody that is called in to discuss a specific problem.

Sequence Models

The next type of model we looked into was the sequence model. This model will represent the actions that takes placed when certain things happen, these are called triggers. Every sequence has an intent which it seeks to achieve every time the sequence is triggered. These models work very well to represent a lot of the situations that takes place in the operation room.

The first model we have made represents a big part of the ODC engineers' jobs, to monitor the drilling and assist when needed. Like in this situation where the trigger is that the ODC engineer observes some strange values from a well, then step by step shows what the engineer do to get control of the situation.

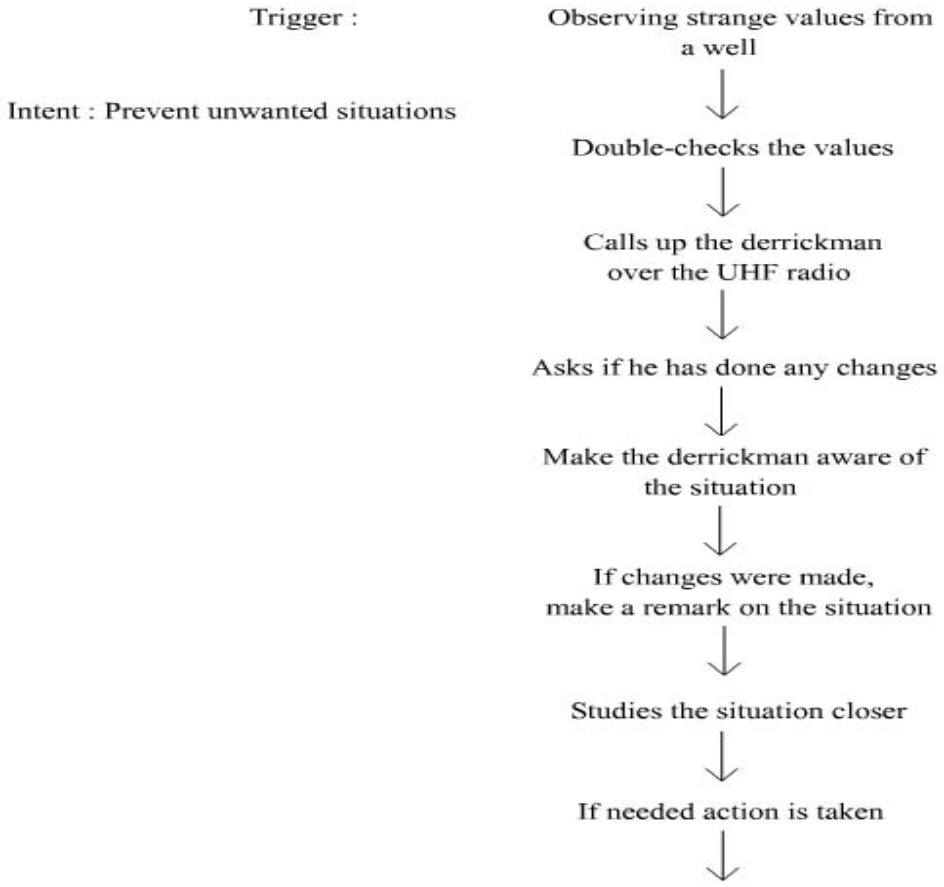

Figure 7 – Unwanted situation sequence model

The second sequence model shows what you got to do to adjust the CCTV camera today. This is an extensive operation as of today and far from optimal. Extensive in the way that you have to get up from your desk and move across the room to do, this indicates that here it is big room for improvement. Today the cameras also are controlled from the rig and if somebody in the operation room wants to switch camera or rotate the camera they have to ask the drilling leader to do it.

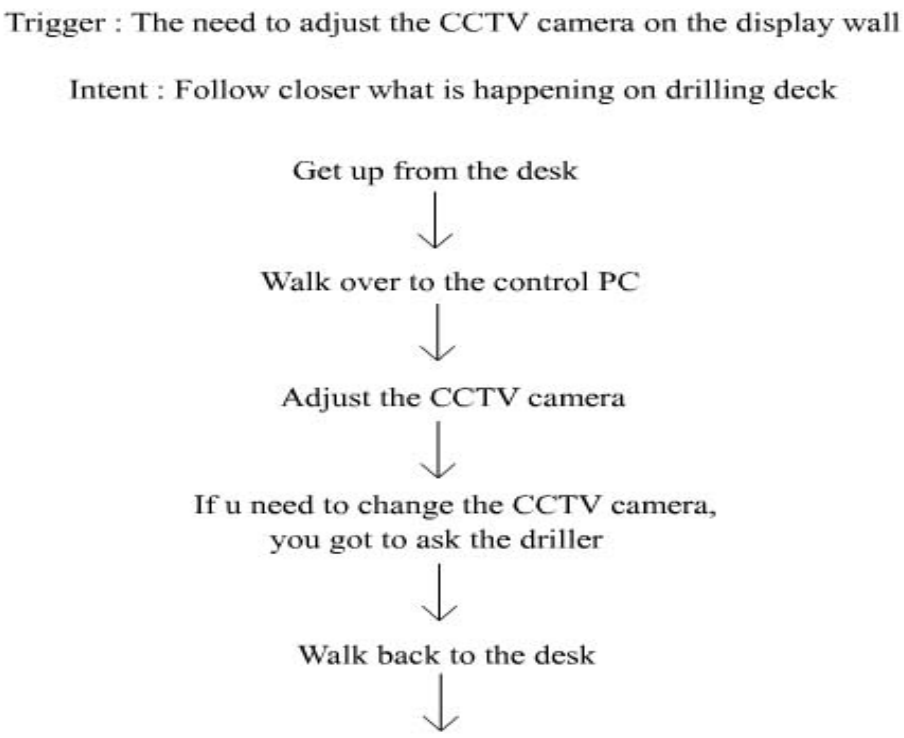

Figure 8 – CCTV display wall adjustment sequence model

The third sequence model represents the steps needed to put information up on the display wall. This is a bit restricted today because you only have one big screen to put information up on from each desk and to adjust or change the setup you have to use the display wall controller who is a separate touchpad PC. This is also a process with room for improvement and more flexibility.

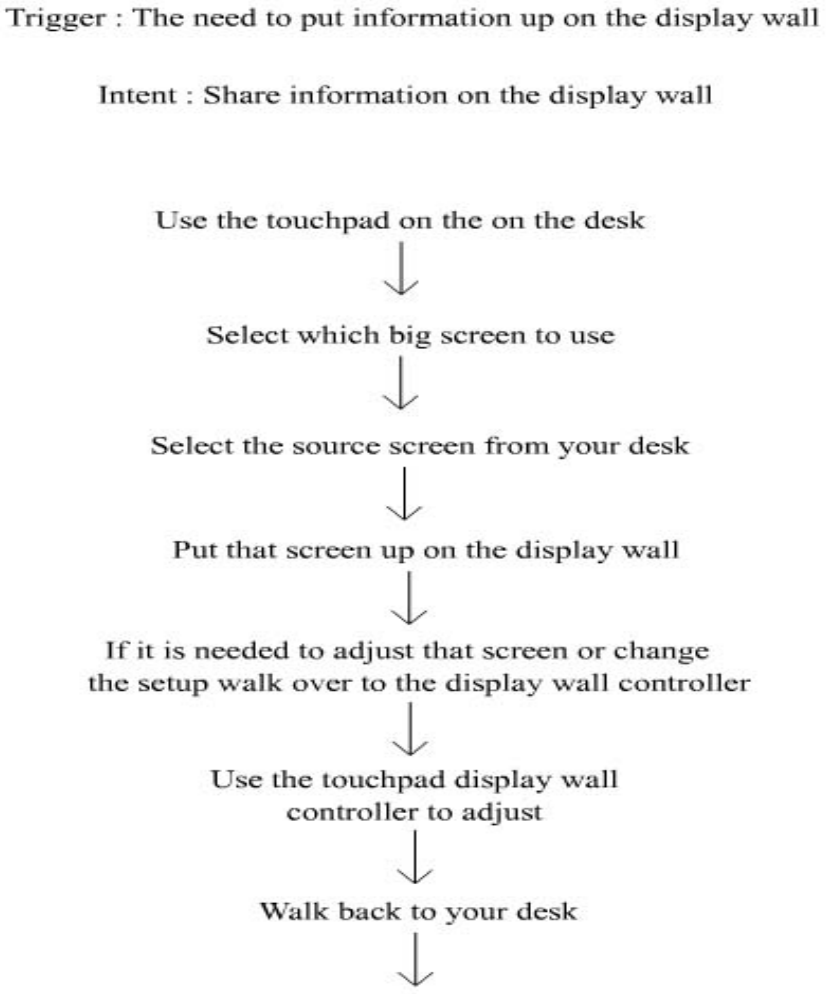

Figure 9 – Desktop sharing sequence model

Physical Models

The physical models represent the physical environment, we choose to focus on the operation room and the collaboration room since the visualization room was not used that much. Nobody used it during the time we spent there and it was mainly geologists that use it to study formations in the sea floor to find the right places to drill.

This models show the layout of the rooms and the hardware besides what they have on their desks. The desks are equipped with three screens in the middle with a web camera on top of these. To the right there is a touchpad computer that is used to put what is on your screens up on the display wall, regulate the desk up and screens up and down and adjust the lights in the room.

Under the touchpad there is a cabinet which was supposed to store the two computers that are used on the desk. However they could only fit one of them into it and had to place the other one under the desk beside the cabinet, which limited their movement around on the desk.

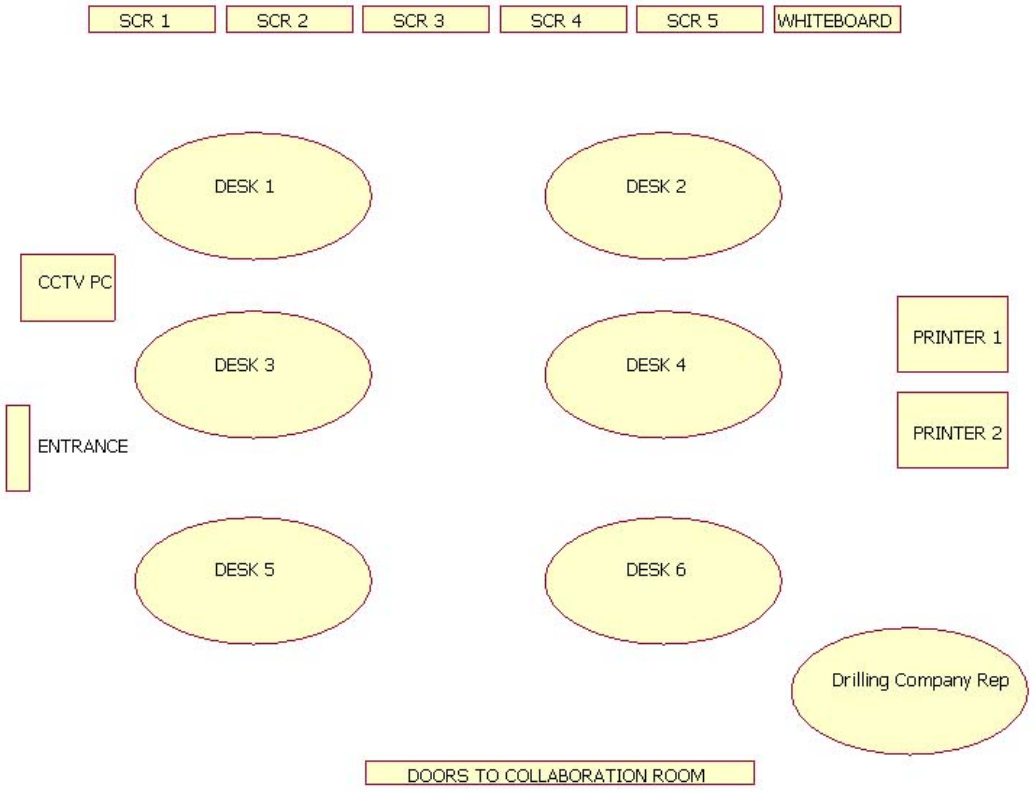

Figure 10 - Physical model of the operation room

The model of the collaboration room is a bit “simpler” since it does not contain that much equipment. It has a touchpad computer to set up and control the conferences which work on a Creston system which is placed on the conference table as the model shows. You have also got a PC to control the smart board to make full use of its possibilities. Between the operation

room and the collaboration you have a glass door wall so you can se what is going on in the other room.

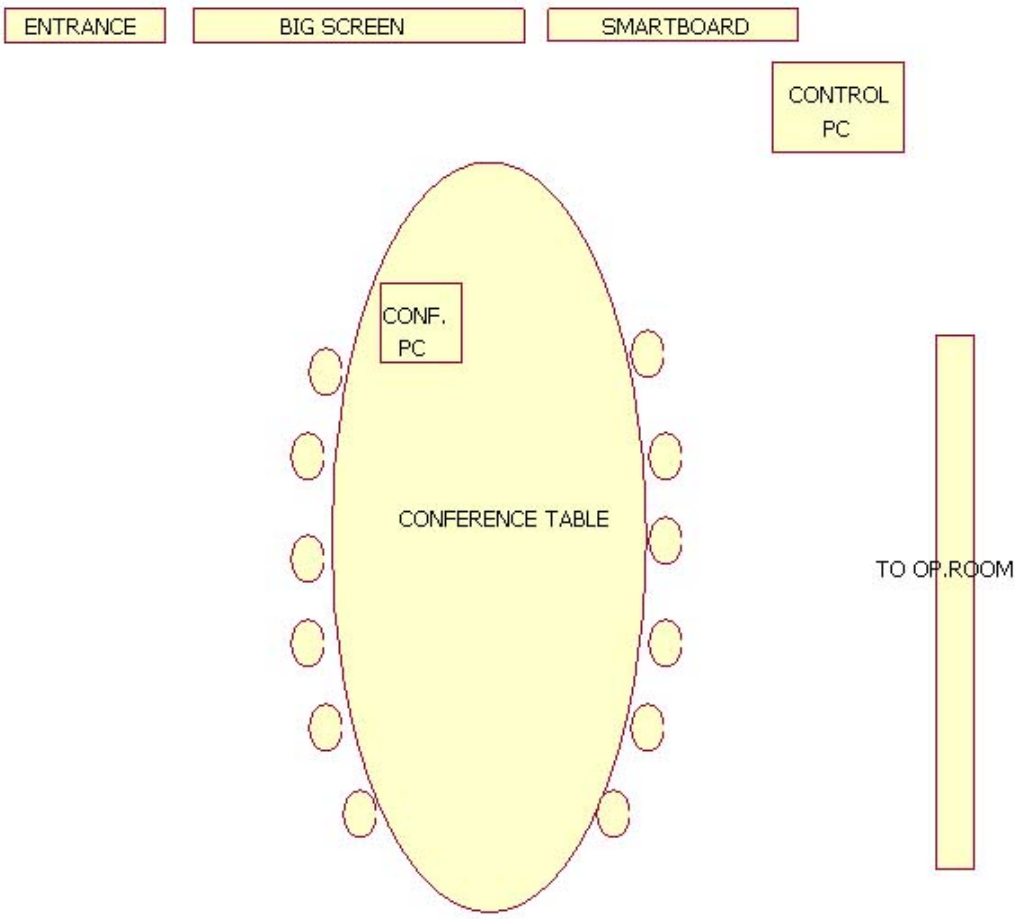

Figure 11 – Physical model of the collaboration room

2.4. Consolidation

2.4.1. Method

Systems are usually not designed for just individuals or one company; they are design to fit into a market. This means companies with similar work structure. Consolidation is the part of the process where you look at different customers that are possible users of this system and compare their work structure. This is done to create an image of the entire customer population.

Then you create one affinity diagram and one set of work models that are representative for the entire customer population.

Affinity diagram

This diagram shows the notes from the different interpretation sessions organized in a hierarchal structure. This is done to discover the common features from all the workplaces. In the diagram this features are grouped together so all the data in one category are shown together.

The affinity diagram should define key requirements of the design like rehabilitee, performance and hardware support. This should enable a designer to see the key features and all the key data that helped to identify these features.

Consolidation of the work models

Each work model contains own details that are used in the consolidation process, so the process is different for every work model. The customer's intent is the number one most important thing to get out of these models. Then the next step is to create strategies to accomplish these intents. The designer can choose to put the some of the strategies into the system or improve them.

The strategies then become structure which then again represents concepts. The last thing to influence this process is the customer's mind-set. These aspects are the key to an effective system design. The work models help the designer to understand these aspects and how they differ throughout the customer population.

2.4.2. Experiences

The third step in contextual design is the consolidation of the work models. This means to gather information from different places and companies, and work out models that represent the whole customer population. From that you can design a product that is going to fit a broader range of companies.

In our case we did not get to do this, and our information comes only from ConocoPhillips. We had hoped to also visit the Statoil ODC in Stjørdal but this was not possible to arrange during this project period. This was mainly because this winter Statoil appointed a new boss

for their ODC and in this transmission period they said they did not have time to tend to not business related activities. So this was out of our hands and unfortunately nothing we could do about it.

This meant a closer collaboration with ConocoPhillips in Stavanger which worked out fine. Since these centers have just been introduced and the working practice in these has not really settled in yet, there is a lot of issues to address.

The form for consolidation we got was from watching two shifts and different people. Since people tend to have different views on what is important, which proved to be right, with for example the shape of the desk that most users found not so good, others like it.

Since we did not get to gather information from more than ConocoPhillips then the work models from step two of contextual design are consolidated and ready to be used in step four to redesign the work process. The results here are the same as in the work modeling chapter.

2.5. Work Redesign

2.5.1. Method

This step is about inventing the new work practice where you work you're new ideas into the work models. These ideas are based on the data collected from the customers; the technology that's available and how to use it solve the design problems. The main goal in this step is to design work practice, which is done by applying the new design ideas into the consolidated work models.

The Consolidated Flow Model

The consolidated flow model is the best place to start to understand work practice and driving design. This model shows the roles people take on and the flow that supports these roles. It reveals communication patterns and problems related to work. These roles are mapped to individuals and each raises different problems which will be discussed in this step.

Key elements:

- Role switching
- Role strain
- Role sharing
- Role Isolation
- Process fixes
- Target the customer

The Consolidated Physical Model

This model deals with how you can adapt the physical environment to best suit the work situation. Wall and buildings aren't so easy to do something with, but rooms etc. can be reorganized to fit the work process. The model shows what limitations you have to deal with and what structure people create within these to get the work done.

Key elements:

- The reality check
- Work structure made real
- Movement and access
- Partial automation
- Process fixes

Consolidated Sequence Models

These models show what intents and strategies people have to do a specific task. It makes a detailed structure of this task and is the best way to match and extend how people solve this task.

Key elements:

- What the user is up to
- How users approach a task
- Unnecessary steps
- What gets them started
- Process fixes

2.5.2. Experiences

When we started to redesign the work process we aimed to work our ideas for how the IMEX prototype would improve the work process into the work models. This resulted in quite large changes in some models and not that much in others. Our prototype ideas lead to some indirect changes; these did not directly affect the model but things in the background.

The sequence models for use of CCTV and desktop sharing was drastically simplified. The intended IMEX solution removed some steps from these and made the process of using these tools a lot easier. So these models were well suited to illustrate the possible changes in these work processes. The flow and physical models did not directly change, but we found that IMEX open up some possibilities that do not exists today. So these models also provided some things to take forward into the development of the prototype.

All in all we got a lot of issues to take forward to the next step of the process, and a solid base of information to work on.

2.5.3. Results

Flow Models

The flow models will not be directly affected by the introducing our IMEX solution, these effects will not show up on the model itself but there are some things in the background that will be changed because of it.

The model with the organization overview will stay the same, what IMEX will do here is to make it easier for all the involved people to communicate and work even closer together. With IMEX comes the ability to put more screens from each desk up on the display wall which makes it easier for the other engineers in the operation room to keep track on what the others are doing and help out if needed.(FIGUR nr ?)

The possibility to share screens from person to person will also contribute to make it easier to discuss problems without being in the same room. This means fast access to information for office personnel around the ODC, when they need it. They can then follow the drilling through one person in the ODC and get the values and parameters they need to do calculations for example.

IMEX will probably also change the ways of communication to some extend. The UHF radio is very hard to replace since they move around out on the rig with it, and will still be the main communication channel for short conversation between onshore and offshore. The use of phones we hope to reduce with a better system for personal video conferences and make it so

easy to use that this will be preferred over making phone calls. The positive side effect of this will hopefully be that the people working offshore and onshore will get a greater feeling of closeness, since now you can see the person you are talking to instead of only hearing him.

The second flow model showing the daily video conferences between the rigs and the onshore support teams will also stay the same. The greatest change here will probably be how to set up the conferences, if today's Creston system is replaced with an IMEX client also on the conference control system then the set up of the conference will be made easier then it is today. The ODC engineers mentioned that today's setup contained a lot of buttons and was a bit confusing since they were not explained that well.

With our IMEX solution we hope to make this easy enough so that even people who have never seen the system before can set up conferences without much trouble. It will be easier for the person leading the conference to call up the wanted rig and handle the rest of the set up.

Sequence Models

The first sequence model will not either be change that much by the IMEX introduction. Since the UHF radio still most likely will be the communication way of choice. If the derrick man is at his desk then maybe personal video conferences can be used for some conversation based on how busy he is, if he is doing several other things at the same time he might not have the opportunity to do this.

Otherwise the screen sharing system can help the ODC engineer to get a quick second opinion on the matter either by dragging the screen in question up on the display wall or just sharing it person to person.

The big changes come in the next two models, about CCTV and information sharing. With the IMEX system you get to control the available cameras from the rig from the IMEX client. This means you can control everything from your desk and save the trips over to the control PC. A bigger selection of cameras which can be sorted after which platform you're monitoring shown by thumbnails that are one click away is the other big improvement here.

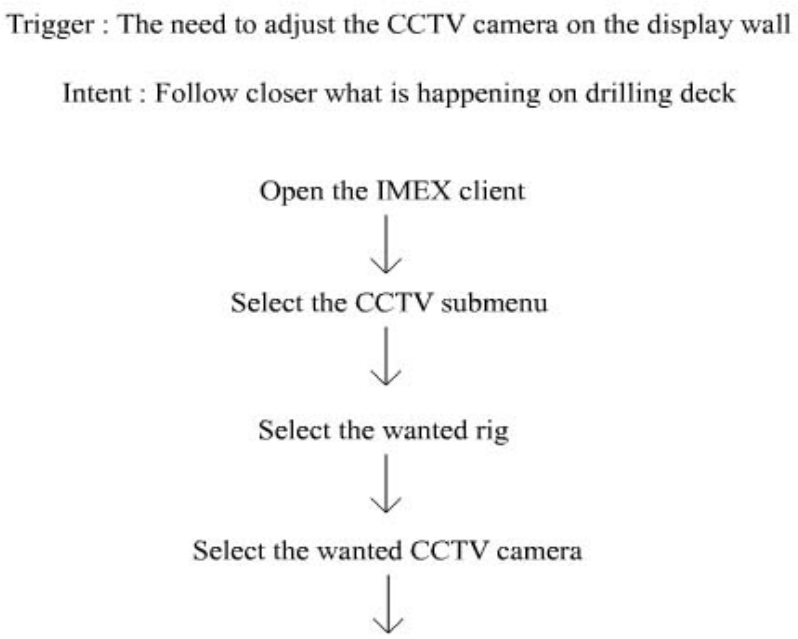

Figure 12 – CCTV redesign sequence model

With IMEX you also get the possibility to watch more than one CCTV camera at once and you can do this on the screens at your desk. This is done by dragging it out of the IMEX window so that it opens its own window for that specific camera. This you can do for as many cameras you like and you can put more than one up on the display wall if you would like.

In the same way the information sharing will be simplified through the IMEX client, here you go through almost the same routine. You open your client, select the information sharing submenu, then you click on the wanted source and then on which screen on the display wall you want to use.

The sharing of screens from person to person will come as a supplement here so you will be able to share information with everybody that has an IMEX client also outside the ODC. This is an interesting part since how can you incorporate this with outside suppliers etc., people who do not have an IMEX client but you would like to be able to share some information with without them getting any access to anything else. This will be discussed more later.

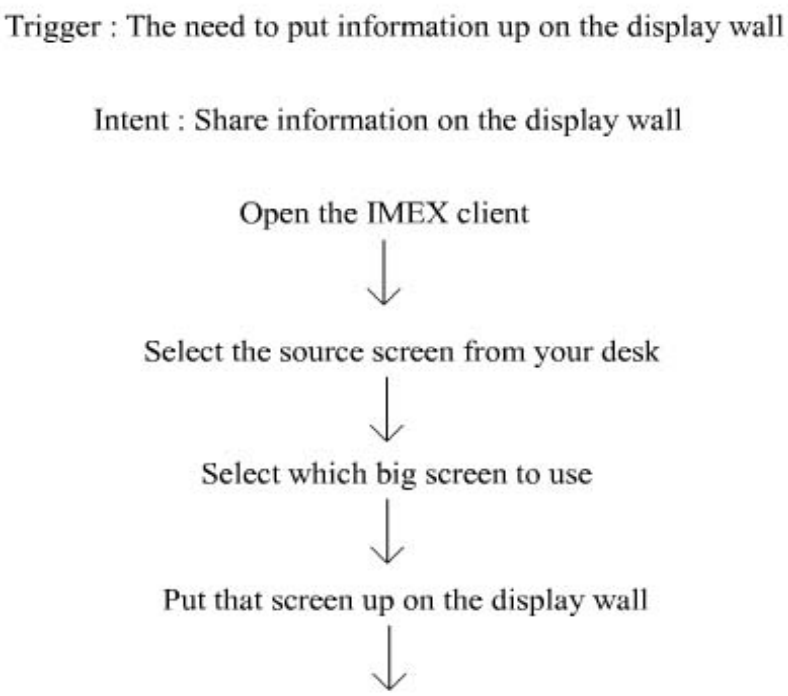

Figure 13 – Desktop sharing redesign sequence model

Physical Models

The changes to the physical models are more indirect consequences of the IMEX introduction, but still important to the working environment. Most of the changes will apply to the desk, because the user had a lot of input here and there was quite a few things to address.

The first thing is the possibility to remove the touchpad since all its functionality and move them into the IMEX system and you can do all the operation it contained from the IMEX client. The screen sharing is now a part of the information sharing sub menu with extended functionality. This was the main use they had of this touchpad, but all in all it was not used much at all.

With the touchpad gone hopefully its possible to remove the cabinet under it and come up with a better solution for storing the computers. This to provide the ODC engineers with better movement on the desk, which was an issue in today's situation. This frees up the right side of the desk to other uses and makes it easier to have another person working there together with you if necessary.

All the room control options will be moved into it including temperature, desk adjustment, curtains adjustment and lighting. All these options can be easily done with nearly the same user interface in the IMEX client as on the touchpad and give the possibility to add more functionality into them.

We will add some new functions to the existing two; especially the light system will be redone, while the desk adjustment will function the same way as before. Together with these will add temperature control and the possibility to open and close the curtains in the different rooms.

Most of the ODC engineers were relatively satisfied with the collaboration room; the biggest problem there was that it has a limited number of seats. When we participated in one, there were people who had to sit in the back because there was no more room around the conference table. So the need for a bigger room or if possible a bigger conference table was definitively present.

2.6. System Design

2.6.1. Method

The next step in contextual design is to make the structure to support the new system and design ideas from step four. This is achieved with applying processes called user environment design and reverse environment design.

The User Environment Design

This is a new technique to represent the system work model. It's used as a "floor plan" as it represents key elements for supporting work practice with software systems. Its show all the aspects that's important to the users and how these aspects relate and support each other. It contains no user interface details; it only focuses on the underlying structure.

This technique focuses on the key elements which are grouped together in the system (focus areas), these coherent elements supports one or more activities in the work. These element groups are the "rooms" of the system. The rooms are supposed to provide support for the work that happens within them. The concentrate only on the work they are supposed to support and the functions needed to do this.

All these focus areas are connected so you can move between them as your work requires it. All representing different activities related to the work and the structure needed to do this work. This model helps the system structure fit the work structure.

The Reverse Environment Design

This model is the opposite of the one above, its built to represent a product that already exists. This technique has several uses like analyzing a similar competitive product , reveal the structure of several systems that going to be integrated or to represent an existing system version that going to be expanded.

Systems have a tendency to get more unstructured over time; lots of new features and modules get added and can become quite a mess. Therefore it's useful to make this reversed model to see the structure in the existing product before attempting to expand it. You can use

storyboards to model the new work process for the next version to keep the design coherence when implementing new modules.

This model is also used to step back from a system to get a better insight into it. This can reveal values and assumptions of the work built into the system. Then the designers can decide if these are useful or not. This model gives them a way to see what the users of the system experience when they use it.

2.6.2. Experiences

We found this step to be not very relevant in our case, since our case is a bit special when it comes to the setting around the introduction of the IMEX solution. This is going to be a stand alone application which is going to contain most the communication options needed for the ODC engineers to do their daily work, the exceptions being the UHF radio and phone. The ODC environment and structure will still be the same both hardware and software wise, so this leaves us with how the users will respond to the application.

This step involves how the users will face taking this intended solution in use, and that is described in our chapters about the prototype development, so we will not comment any further on that here.

2.7. Prototyping

The last step of contextual design is the prototyping, using the information from the four first step, we designed a first draft prototype of the IMEX client with emphasis on 4 modules that we found to be the most interesting to start out with. Since contextual design is not a very thorough method when it comes to designing user interfaces and we based our design on the existing design for usability purposes, we have made a own chapter with the results from the prototyping session.

The modules we started out with were CCTV, information sharing, video conferences and room control. We design a first draft, which we brought to Sense for discussion and feedback which we took back to design the second draft. Then we had a new round to Sense before we made some more adjustments before bringing it to Stavanger and testing it out on the ODC engineers.

Then the feedback from the ODC engineers was used to make the the final version. A mentioned earlier this whole process is described in a separate chapter with the changes made from draft to draft and why these changes were made.

3. Our IMEX solution prototype

3.1. Introduction

The prototype was developed in two main iterations. The first version was based on the initial thoughts about specifications from Sense Intellifield, interviews with developers at Sense and the contextual inquiry at the ODC at ConocoPhillips in Stavanger.

The second prototype was altered according to feedback from people working on the IMEX project for Sense Intellifield and was then tested with users from the ODC at ConocoPhillips.

The thoughts posted in this chapter are based on the experiences from all of these meetings. Some of the less used submenus have not been implemented into the prototype. More specific changes between the prototype iterations are found in the next chapter.

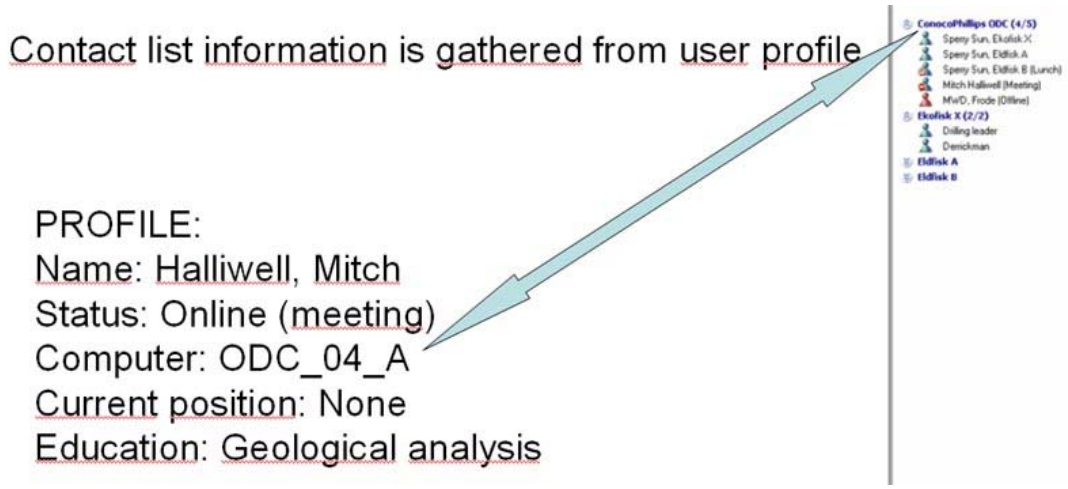

Figure 14 - Profile example

3.2. User profile

For users to be available as individuals in an office environment there has to be a personal login function to the IMEX. Each user has a personal profile, which is updated whenever the user logs on or off from a machine. This profile holds information about for instance the user's name, online/offline status, which machine he or she is logged in to etc. This profile could also include the user's field of expertise, to make him or her available for others to ask advice from. Information from the user profile is used when compiling the contact list.

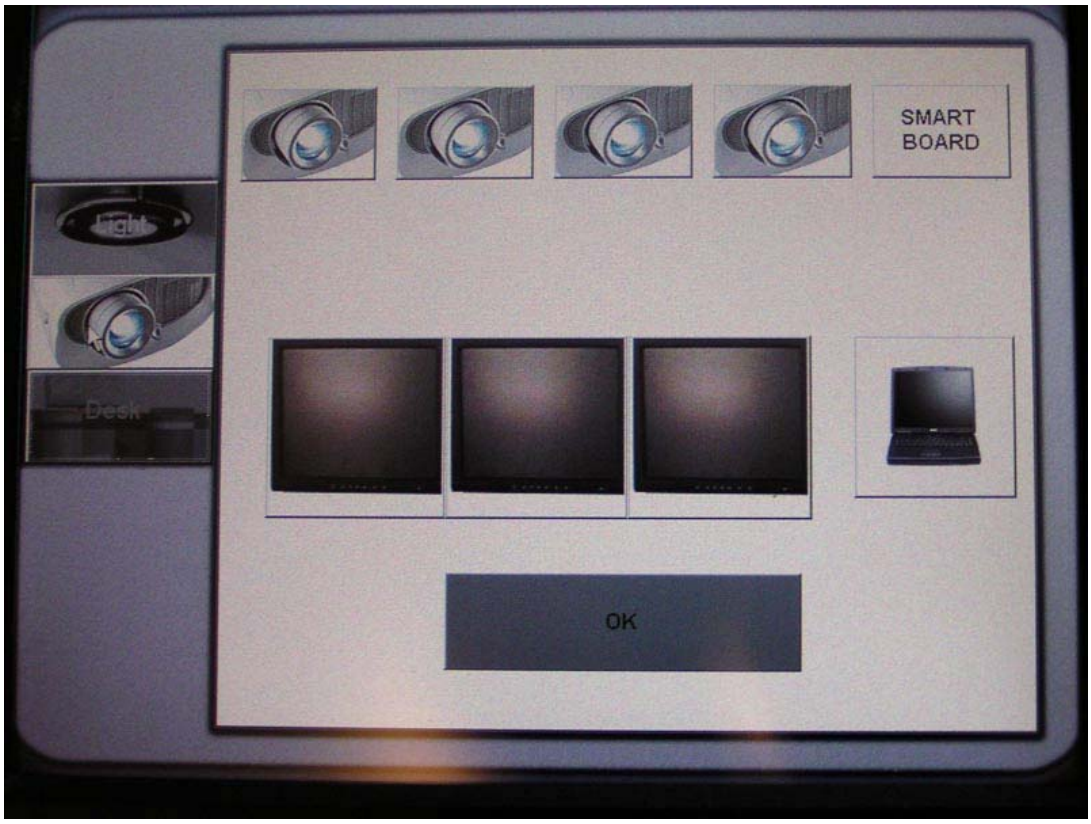

Figure 15 - Touchpad screenshot

3.3. The general UI

To ease the learning process, the thought is to base the general user interface around an interface already known to the user. The current V-COM touchpad implementation uses a simple layout with menu buttons on the left and the main options area on the right. Users at the ConocoPhillips ODC in Stavanger were comfortable with this layout, and would benefit from a continuation of this.

Our experience through the contextual inquiry was that the way the touchpad was designed into the V-COM was far from optimal. The space where the touchpad was placed was used for a lot of other purposes, for instance placement of phones and sheets of paper.

Our idea here is that the IMEX client could adapt the features currently implemented in the touchpad, thereby making the touchpad redundant. Apart from the technical benefits, there are also physical advantages, described in more detail in chapter 2.

Drag and drop

The prototype is based on the drag-and-drop concept well known from most graphical operating systems. The user find for instance the contact he or she wants to add to a video conference, and then just drag the users name or icon into an available video area.

3.4. Menu buttons

The current touchpad software uses buttons covered by an image, with describing text on top of it. When a button is inactive, it is difficult to see what the image portrays, and the text is quite dark. With the increasing number of menu choices and capabilities in the new version, the current system would become confusing for the user.

Each button should be self-explaining with an icon, but because some of the menu items might have quite similar icons, a short title is given to every button as well. The title is placed below the icon, so that it is very readable, both when the button is active and inactive.

An active button has the same background color as the submenu screen, making it understandable which submenu is currently selected.

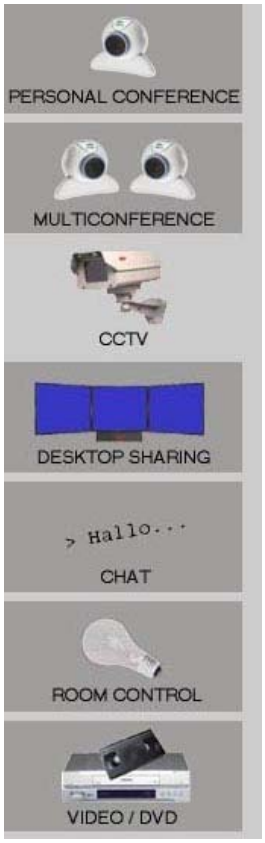

Figure 16 - Menu buttons

3.5. Contact list

Easy communication and cooperation is the target of the new IMEX project. This means easy and fast access to the users or the competence that is needed just now. The user needs a way of reaching his contacts, without perhaps calling their secretary or by other means finding out the location of the contact. Everyone using the IMEX system will be available in a contact list, which is always displayed on the right hand side of the screen.

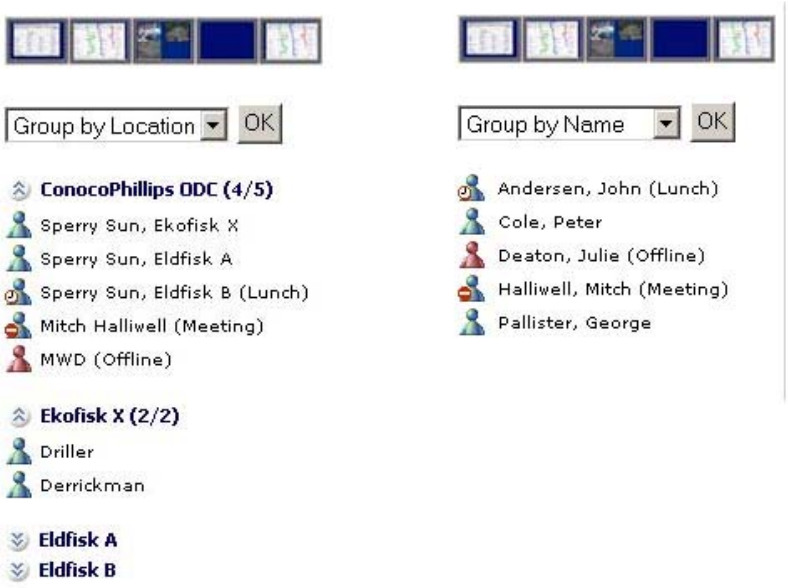

Figure 17 - Contact list

Although not necessary in all submenus, the contact list should be fixed on the right hand side on every screen. This gives better consistency, and the user knows where he or she can find contacts at all times.

The main idea of the contact list is that it gives a fast overview of which persons, location work roles and what kind of competence is currently available. To help the user with his specific contact list search, the list can be rearranged to fit the search. Sort options that should be available are by Last name, by Location and by Competence. The latter two are also grouped into subcategories to increase efficiency. It is possible to close the subcategories that are not in use frequently.

The proposed contact list layout is inspired by Microsoft's MSN Messenger, and to illustrate the layout in a recognizable way, the well-known Messenger icons have been used. The icons can be replaced by other icons, but it is important that they give instant feedback about the user's status, whether he or she is online, away, offline etc.

By right-clicking on one of the contacts a pop-up menu appears. From this menu the user has access to all the communication options related to the selected contact. Possible menu choiced can be "Add to Personal Video Conference", "Add to Multiconference", "Share desktop", "Start chat" and so on.

At the top of the contact list, the user will see a small collection of screens, representing a visualization wall in the room where here or she works. The user can drag for instance a CCTV screen or a video conference onto the desired screen to share it on the visualization wall.

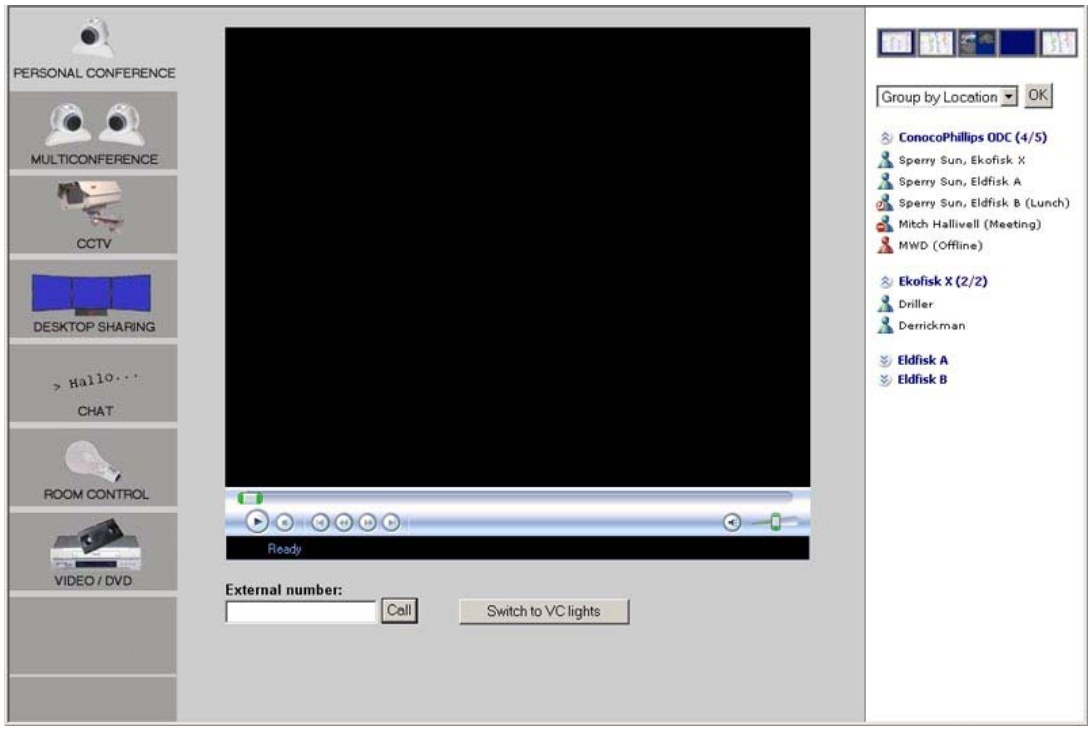

Figure 18 - Personal conference layout

3.6. Personal conference

The personal video conference is meant for easy collaboration between two IMEX users, without the need of tailor-made conference equipment and conference rooms. V-COMs are fitted with a small camera above the monitors that can be used for this purpose. The cameras are not currently in use, but if the IMEX can facilitate easy video conference setup it might be a good alternative to other means of communication.

Users mentioned during the contextual inquiry that closeness and informal environment offshore were things that they missed when working onshore. In an effort to remain connected to the offshore environment they tried to find time for some small-talk on the phone, after their work task has been done. If the personal video conference setup is just as easy, or perhaps easier, than dialing a phone number, then the possibility of actually seeing the person in the other end would add to the collaboration experience.

The personal video conference submenu uses the drag-and-drop concept for easy setup. The user drags the contact he or she wants to talk to into the conference window and the connection procedures are handled by the IMEX.

Although most contacts are available in the IMEX contact list, there is also the possibility of setting up conferences by just using an external phone number.

The video conference screen also includes a button with a preset for optimal lighting, so that the user does not have to switch to the lighting submenu.

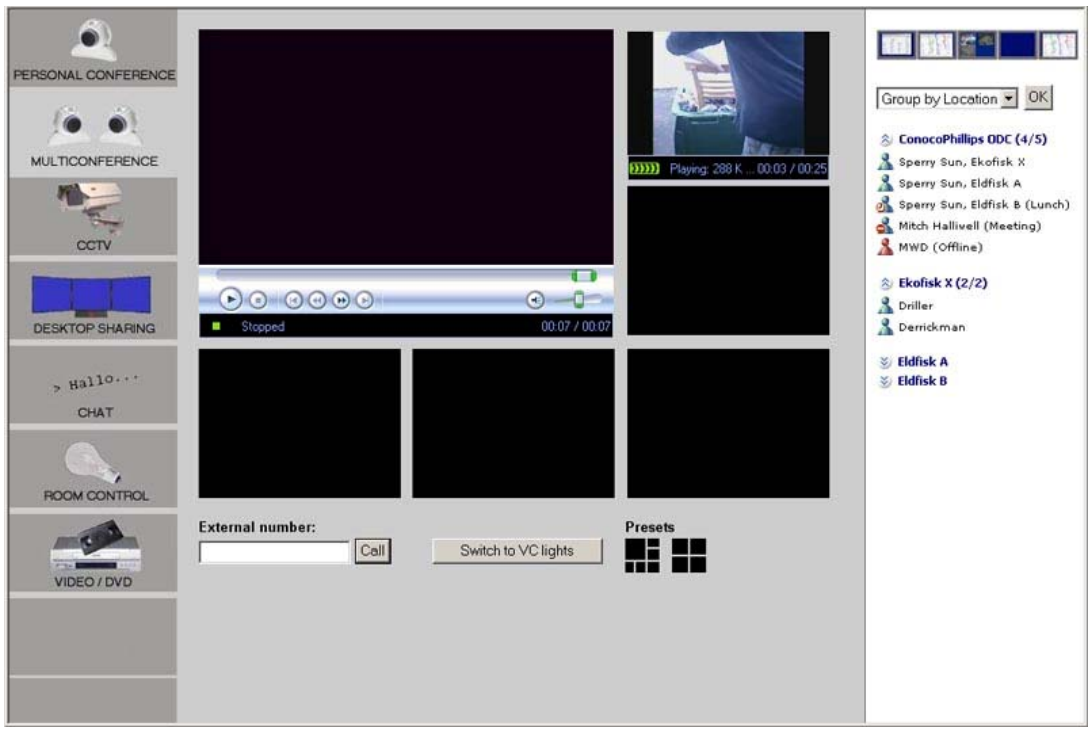

Figure 19 - Multiconference layout

3.7. Multiconference

Multiconferencing uses the same principles as personal video conferencing, but offers the possibility of more than two participants. The main difference in the submenu is that there are several video windows instead of just one. The participants can be dragged into one of the windows to be joined in the conference.

On the bottom right side of the multiconference screen there are images representing different presets for the conference layout. These presets have different sizes on the video windows, to suit different number of participants. The windows should be resizable after a preset has been chosen.

In both personal video conference and multiconference we have chosen to leave out the option that the user can see himself or herself in a small window next to the main conference. The Tandberg VC system currently used in the collaboration room displays this image when a new video conference is started. This is most often followed by one of the participants saying "Hello, can you hear me" or a similar question. On similar systems, like the plain old telephone system, users just assume that everything is working, and start talking regularly immediately. This is what the IMEX should feel like as well.

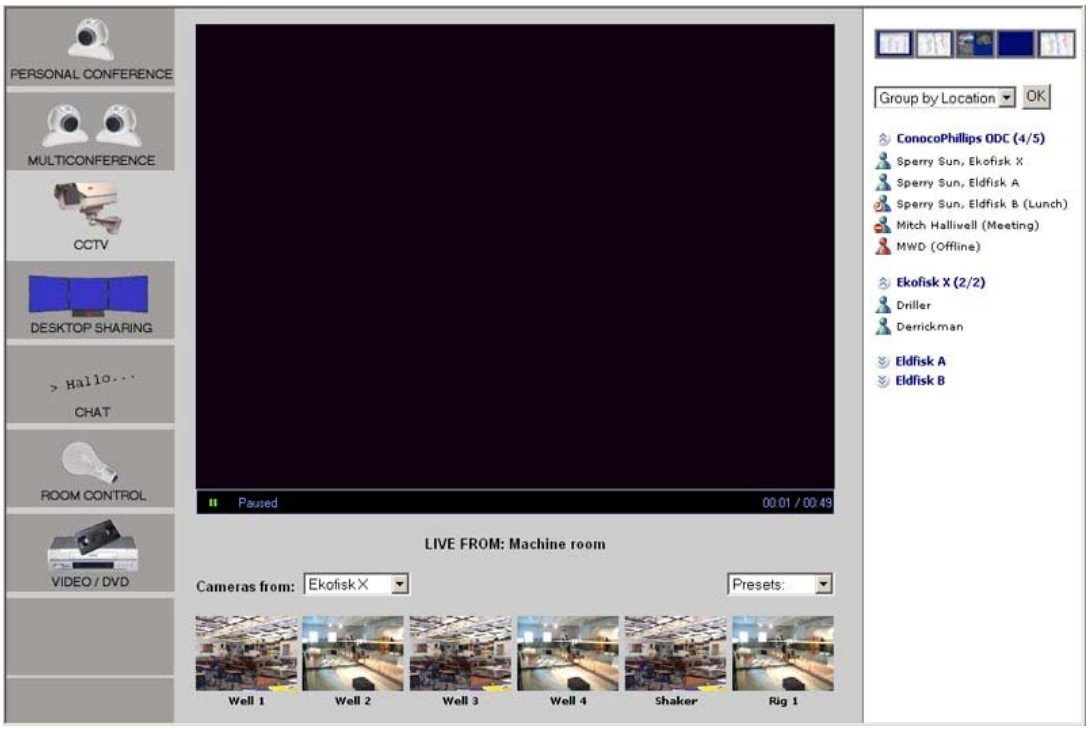

Figure 20 - CCTV layout

3.8. CCTV

The CCTV submenu has been designed with no restrictions with regard to offshore camera access. Ideally, the onshore personnel could have access to all cameras, and the possibility to switch between them as desired.

The submenu consists of a main window where the selected camera can be viewed. Beneath this there is a small menu for category selection. The cameras could be divided for instance by platform. When the desired category is chosen, a set of thumbnails appear beneath the menu. By clicking one of these it appears as video in the main window. Due to bandwidth restrictions the thumbnails can not be small video windows, but rather small images, perhaps updated every minute.

Ideally, the user should be able to drag the video window out of the IMEX frame, to make it a standalone window. By doing this, the user can have the CCTV window open in full screen mode on one of the monitors, while working with other things on the other monitors.

Figure 21 – Desktop sharing

3.9. Desktop sharing

Information sharing between users is one of the main motivations for the IMEX project. Our first prototype had desktop sharing as a menu choice separated from the rest, but feedback from users suggested that desktop sharing should be available from other menus as well.

When sending a desktop, CCTV or Video Conference to other users, the position on the receivers screen could be determined either by the sender or by the receiver. One alternative when sending to a personal station, e.g. V-COM is that the receiver has a specified display that is configured to receive incoming multimedia. The sender would see the three screens and the graphic will indicate which screens are not available for placement.

As another option, the receiver could determine the location himself. This can be done with a user dialog asking the receiver to accept incoming multimedia, containing a similar graphic with three available screens. The receiver chooses the screen where he wants to place it.

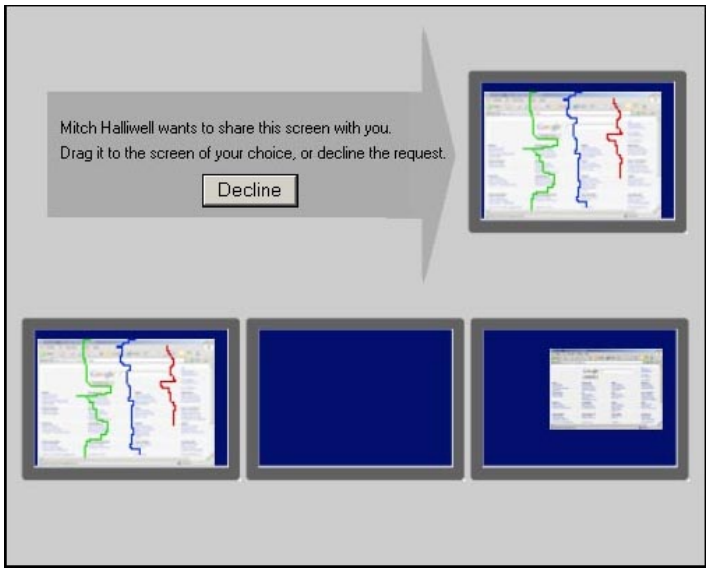

Figure 22 - Monitor sharing dialog box

For the visualization walls and smartboards we find it feasible to introduce a "master", who is responsible for content sent from users outside the room. It would not be advisable that outside users could determine the contents of the large visualization walls. Requests for change on these walls will pop up in a dialog box on the master's desktop in a similar fashion to the personal desktop sharing. This dialog box will display 5 instead of 3 screens. In addition the SmartBoard could be displayed as an extra screen. To enhance usability this dialog box should appear at the same position each time it occurs.

The user should also be able to remove a screen from the visualization wall. Closure of a window should replace it with the background image on the visualization wall. It should not be necessary to replace it with a new screen.

Just as in the current solution, it must be possible to connect a laptop computer to the V-COM, and to share this display one the wall as well. When you connect the laptop or similar device to the V-COM, this display should be shown as an extra monitor on the desktop sharing menu.

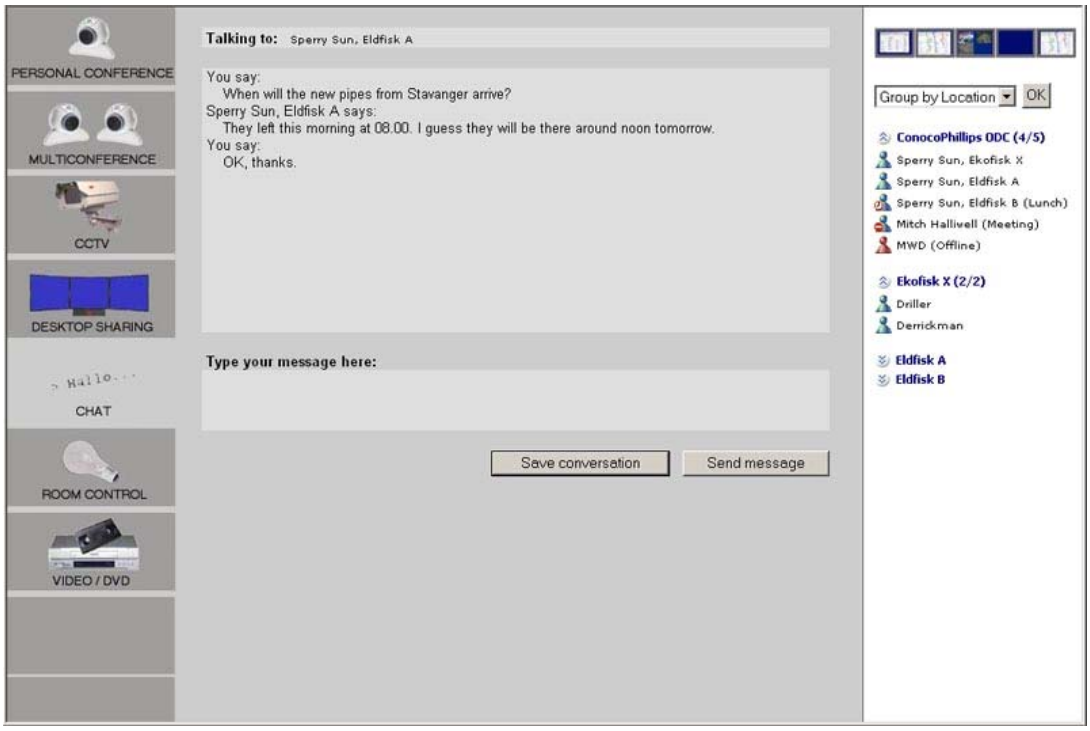

Figure 23 - Chat

3.10. Chat

The chat feature looks a lot like standard instant messaging clients, like Microsoft's MSN Messenger, Mirabilis' ICQ etc. It can be used for instance to send a message to a person that is away from the computer. The recipient is dragged into the chat window; message is written and then sent by clicking the "send" button. The user also has the option of saving the conversation, by the click of the "save" button.

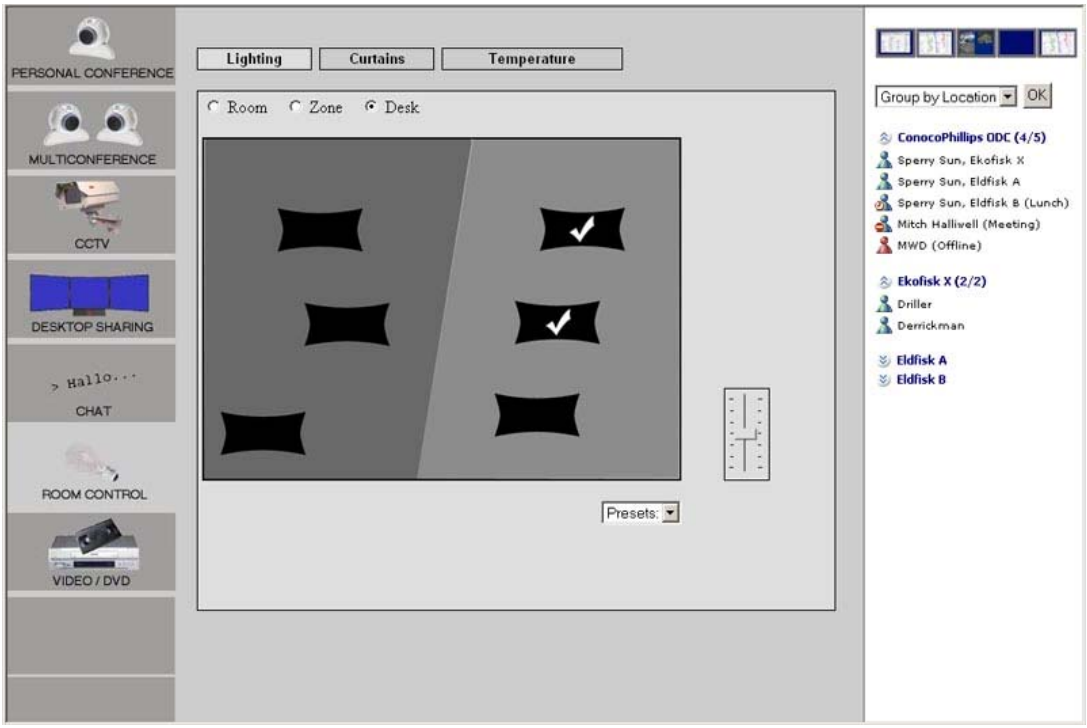

Figure 24 - Room control zones demo

3.11. Room Control

The features currently implemented into the V-COM touchpad are moved into this submenu. As there are several subcategories, these are divided into subpages by a menu bar in the top.

Lighting control is a feature that does not work optimally today. The different controllable areas are denounced as “Zone 1”, “Zone 2” etc, which is a bad usability solution.

The proposed design includes a graphical overview of the room that is recognizable to the user. If possible, the graphic could show feedback about how the lighting is in the room at the moment.

There are three ways to adjust the lighting. Adjustments can be made to the whole room, to a zone in the room or to the lights just above one desk. For zone adjustment, the user first defines what desks the zone consists of. A slidebar is used to do the adjustment itself.

Some users told during the contextual inquiry that they like to dim the lights a bit down during the night shift. This should be entered as one of the available presets at the bottom of the screen.

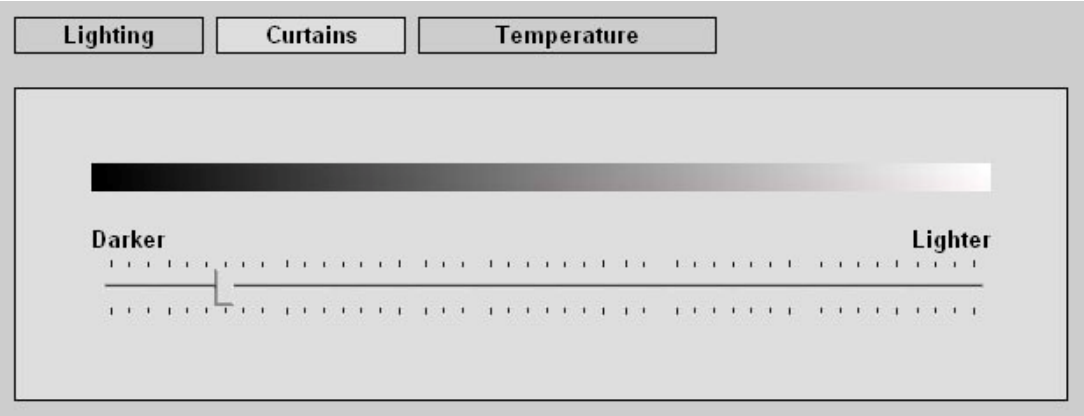

Figure 25 - Curtain control

Curtain control is a feature that is not in use at the moment. The curtains at the ConocoPhillips ODC are currently operated by hand. In the prototype, the curtains are controlled by a slidebar beneath a grayscale colorbar that show the amount of light that is let through. Depending on the curtain layout, this control could also be implemented with an up or down slidebar. This would be based on the profile of the room in which the user's computer is placed.

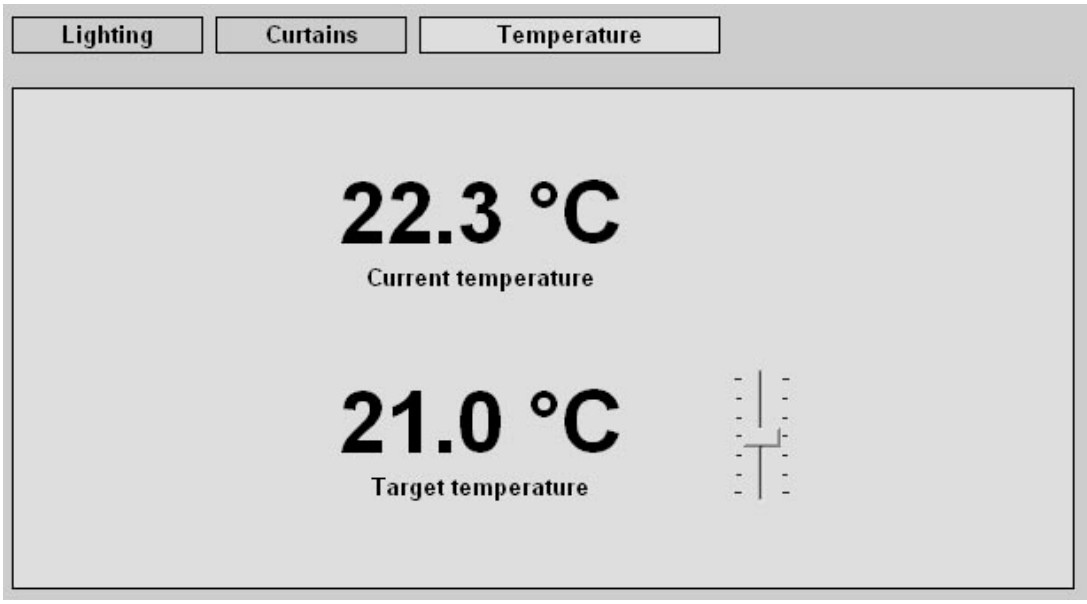

Figure 26 - Temperature control

Temperature control is pretty straightforward. Two displays are shown, one showing the current temperature, and another showing the desired temperature. The desired temperature can be adjusted by using a slidebar. A solution where the user enters the desired temperature by using the keyboard is also possible, but almost everyting in the IMEX prototype is done by use of the mouse, and making the user move his or her hands to the keyboard seems unnecessary.

Desk control is used for adjustments to the physical appearance of the V-COM by heightening or lowering the table and the monitors. The implementation of this is not perfect today,

because the user has to manually make sure that the monitors are set to be higher up than the table.

According to developers at Sense Intellifield this was something they wanted to be done automatically, but their efforts to make this work in the first version had not been successful due to software compatibility problems.

3.12. Video/DVD

Although several users hoped this menu choice meant that they could watch movies while working, the Video/DVD submenu is mainly designed for operation of such devices in conference- and collaboration rooms. We have not focused on this part in the prototype, as it should be a straightforward approach with regards to the screen layout. Standard control buttons like “Play”, “Stop” etc. should be implemented as virtual buttons, but are used in the same manner as normally.

3.13. Visiwear

Visiwear is a small and wearable mobile device that can be used to transmit video and audio for use in for instance video conferences. The small camera delivers a high quality video stream that is sent wirelessly to a web server. The user logs on to the web server at Visiwear, and can select the active camera from there. The video stream is then watched live over the internet.

Visiwear equipment makes it possible for decision-making staff to sit in a collaboration room onshore, and still get quality information about for instance a broken gauge on a platform offshore. The operator can interact with the video conference participants and use the camera to show what they want to see.

The first version of IMEX from Sense will offer few enhancements from today’s model. The user will be sent automatically to the login screen at Visiwear.com, and will then proceed as it is currently done.

Ideally, the IMEX should be more closely integrated with Visiwear. Instead of going to a login screen at visiwear.com, the access rights should be specified in the IMEX user profile. Visiwear should be accessible as a menu option, and could be designed in a similar fashion to CCTV, where the user chooses between the active cameras. Design for this feature has not been implemented in the prototype

3.14. Document Camera

Another tool used in collaboration rooms is the document camera. This works very similar to the traditional overhead projectors or regular scanners. A document is placed on the frame and a camera is used to display the document in a video signal. The IMEX could be used to stream the signal across the internet to for instance a video conference participant.

The document camera also has basic scaling functions like zooming, which can be implemented as for instance a slidebar in the document camera submenu. As document cameras are mostly found in conference rooms, we have not implemented them in the prototype.

4. Prototype evolution based on usability feedback

4.1. Introduction

According to the Contextual Design method, the first version of the prototype was developed after the contextual inquiry and examination of the general IMEX specification from Sense, describing the features that it was expected to implement.

The specification contained no guidelines to the layout of the IMEX, and we therefore chose to develop the first prototype as a storyboard in Microsoft PowerPoint, and use this for further discussion with engineers and developers at Sense Intellifield. There was no functionality.

The storyboards functioned very well and a lot of different ideas were discussed. It also gave feedback on technological areas where our knowledge was smaller.

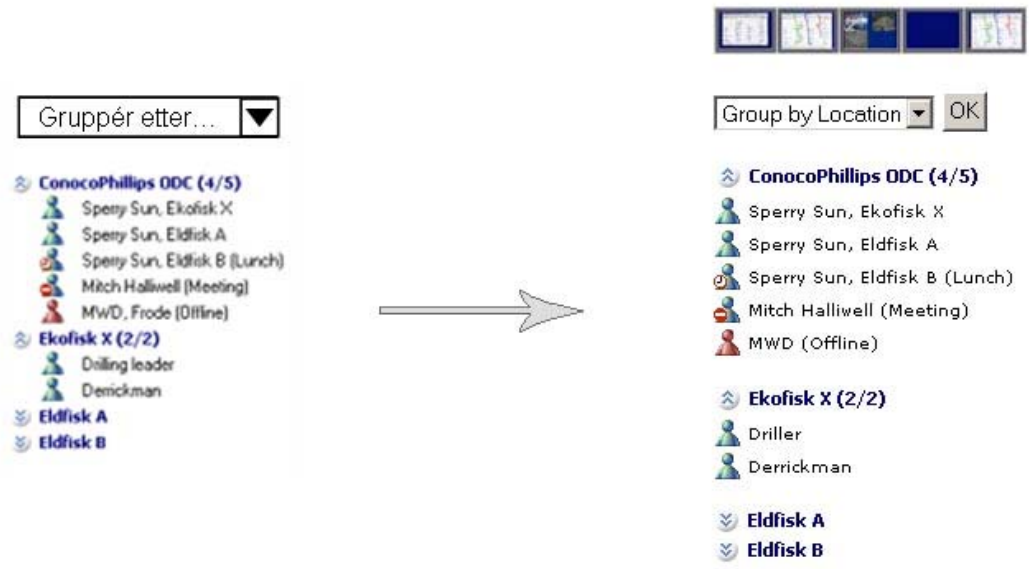

Figure 27 - Contact list evolution

4.2. Contact List

The contact list was created with few features to initiate discussion. The drop-down menu in the top contained no options, but only a description of its function. In the second version of the prototype, the list was implemented and it was possible to switch between sorting by location or by last name.

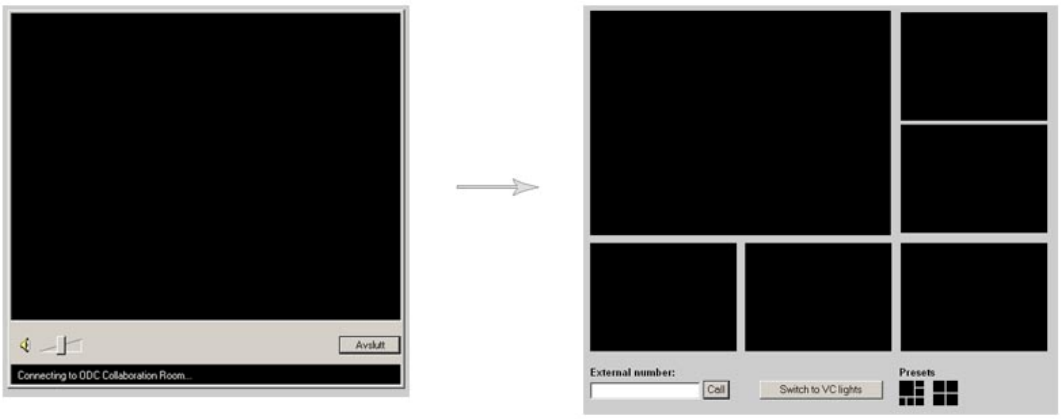

Figure 28 - Multiconferencing evolution

4.3. Video conferencing

This section consisted only of a video area with two controls in the first version. It was possible to adjust volume and to stop the conference. The first remark from Sense engineers was that video conferencing needed to be split into one submenu for personal conferencing and one for more than two participants. Also, the engineers saw the need for the option of joining external contacts into conferences. The discussion on the lighting controls also brought up the need for a quick way of adjusting lights to be suitable for video conferencing. This was implemented with a toggle button in the second version.

4.4. CCTV

The first CCTV layout was well liked, and except from the addition of a preset drop-down menu, no changes were asked for. The first prototype was only a storyboard of the layout. The second version used video clips to demonstrate what would happen if a thumbnail was clicked or dragged onto the live video screen.

The CCTV solution was warmly welcomed by users in the ODC, who liked the easy drag-and-drop access, and especially the fact that they would no longer have to walk over to the wall controller to do adjustments to CCTV cameras.

4.5. Desktop sharing

Our initial design of the desktop sharing function was very similar to the solution already used on the V-COM touchpad, mainly consisting of three screens representing the user's V-COM monitors, and five screens representing the visualization wall. This option is still available, but the IMEX application is much more complex than the touchpad system, and one of the main principles of IMEX is to make sharing easier.

As was pointed out in the first meeting at Sense Intellifield, the desktop sharing function has to be available, not only for sharing of a complete monitor, but also a CCTV camera or a video conference should be possible to add to the visualization wall.

For our second version, we have therefore placed five small screens, representing the visualization wall, at the top of the contact list, where it is accessible at all times. The user can drag a CCTV camera, video screen, video conference etc. onto one of the screens to share it. This solution helps with consistency, in that every interaction with items placed in the contact list on the right has to do with sharing with other users.

4.6. Chat

The chat function is perhaps one of the easier submenus with regards to implementation. The chat window layout looks very similar to other instant messaging clients like Microsoft's MSN Messenger or Mirabilis' ICQ.

There were few comments to the proposed design, but designers at Sense wanted to be able to save the conversation with a simple click of a button. This button was implemented in the second version of the prototype.

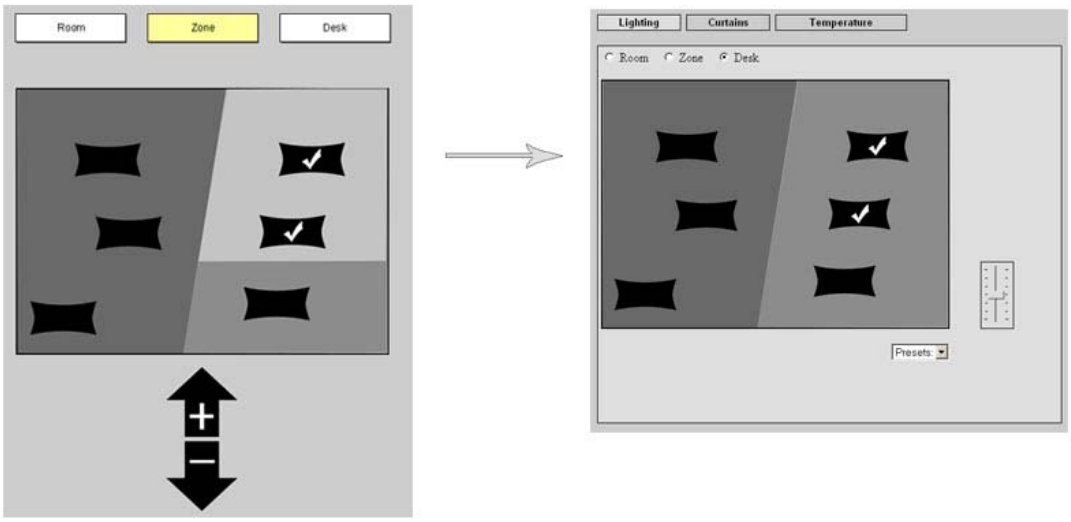

Figure 29 - Room control evolution

4.7. Room control

In the first storyboard this menu button was called "Lighting", but it quickly became clear that this submenu should also include other options, like curtains and room temperature. "Room control" seemed like a more obvious label.

Only concerned with light adjustment, the first prototype was well received at Sense. However, engineers wanted to replace the touchpad-inspired "up" and "down" arrows with a slidebar. There was a discussion concerning whether it would be technically possible to control lights in the proposed way, with user-defined zones. The conclusion was that it would be possible, and the design was accepted as a possible solution.

Among the few changes made for the intermediate prototype was the inclusion of temperature adjustment. This was implemented with two numbers, showing the current room temperature and the desired (target) temperature. A simple solution wit a slidebar to adjust to target

temperature was accepted as a good way of doing it. The less complicated, the better, was the opinion.

A way of adjusting temperature was highly appreciated by the crew at the ODC, where temperatures currently vary with the time of day based on the amount of activity in the room.

In the final prototype, curtain control was also added. Different curtain setups are possible based on the buildings in which the centers are placed, and due to this the only graphical feedback was a bar showing changes in brightness, from darker to lighter.

4.8. Other features

On the final prototype, a button with Video/DVD was added to the menu, but no submenu was implemented here.

5. Discussion

5.1. Contextual Design

The choice of method for collecting data was quite obvious in this case, contextual design is the strongest method when it comes to gathering data since it is based on observing the users while they do their daily work. In addition you can ask further questions when you want to go deeper on a issue, providing you with very accurate data based on the users themselves.

These data are taken into the next step, which is creating work models. The five types of models that contextual design contains each represent important aspect of the work process. Here you can find the models which fit our case best, if you not find it necessary to use all five. These models provide a great way of organizing the discovered data and present the actual work process. Then you can take these models back to the users and work together with them to get the models as accurate as possible. This is a mechanism to ensure that you go into the next phases with correct information.

If the system you are designing might be taken in use in more than one company then through the consolidation step you can do the same process at other companies to get a system that is flexible to fit a greater customer population. This makes the method very thorough and suited to use in most cases.

Redesign of the work practice is then based on these models, which means it is based on real data rather than assumption. This ensures that you get a system that is based on the actual work of the customers. The improvements you make in the models reflect the possibilities to make changes in the work process. If you cannot make any changes at all this means it is not possible to change the work practice. Contextual Design also has steps to ensure at the system gets a good structure.

The weakest part of contextual design is the prototype development, since it gives little guidelines on designing user interfaces. However the suggested paper prototypes work well to cooperate with the users to get their views on it. So the greatest advantages with the method is the great detailed data you get and the mechanisms that ensures these are accurate, the disadvantage is that for designing the prototype other theory is necessary.

Contextual design is a comprehensive method and it takes some time to get a good overview of it. Since it was the first time we used it, it was a quite time consuming to work through all the steps, but this shows how thorough the method is. It fit our context good and proved to be a great way to collect, organize and obtain improvements.

5.2. Prototype development

Several of the findings from the contextual inquiry were used when developing the prototype. The contextual inquiry was a good way to ensure a user-focused design. Although we were allowed to develop a prototype without consideration of technology restrictions, we wanted to get feedback early in the process, to make sure that our thoughts about the prototype did not

differ too much from the developers' goals for IMEX. The first version of the prototype was implemented as storyboards in Microsoft PowerPoint.

For the second prototype we wanted more functionality. This prototype was to be used for testing with real users at the ODC in Stavanger, and we knew that real users would need more working features to understand the application thoroughly enough. This version was developed as a web page with Active Server Pages (ASP) to make navigation and video playing possible.

5.3. Prototype evaluation

The first prototype worked very well as a basis for discussion. The developers had a lot of views on every menu item, and we got a lot of feedback. The biggest change was to split videoconferencing in two. Although the developers often continued the discussion on to a technical level, it was valuable feedback about the challenges in the design phase.

The user testing of the second prototype was very successful. We got very good feedback on the application interface, and particularly the ease of use.

5.4. Further Work

As always under a development process there are some big issues that comes up, that are key to making a system useful. Some were too large to cover in this project, but we recommend that these matters are studied further.

One of these issues with this project is how to make external contacts, i.e. suppliers of equipment, able to connect to the IMEX system to discuss contracts and for support. This should be done without giving them rights to do anything else. There is a danger in giving outsiders access to the internal network of the company, and the more accessible a network is to be, the more thought has to go into the network's security layout.

Through our prototype sessions we discovered it was desired to be able to have the suppliers on the contact list in a way that they can only be contacted and not be able to initiate contact. This is because they want to keep control of their network and prevent the possibility of clients communicating with other clients through the IMEX system about issues not related to Sense.

Another solution that was discussed was to make a web based light client, that they would get a temporary login and password to, which was valid for a shorter period. The IMEX system will have a login, and users or groups that will have rights based on what they need access to. There is also the possibility to make a form for guest user for the external contacts.

Another issue is the possibility of easy connection of external equipment to the IMEX system. When somebody visits the ODC and they want to connect their laptop e.g., the IMEX system have to register which room that laptop is logging on in and give access to the equipment in that room. This equipment then has to be registered in some kind of room profile.

The laptop then will show up as a fourth screen in the desktop sharing sub menu and you will have access to whatever you user profile allows you to. When the IMEX system is taken in use in all rooms in the organization and not only the ODC, then it is important to have a good profile base for all rooms to have a dynamic system.

It would be interesting to assess whether IMEX can replace what the current Crestron systems in use in collaboration rooms today. If the IMEX application can support the same features as Crestron do today, it would be beneficial to have the same interface throughout the company.

The IMEX client integrates a lot of existing technologies and systems into one, but is it optimal to include everything? We have left the rig radio system out of the prototype, but it could of course be streamed through the IMEX. The advantages and disadvantages of this should be studied more thoroughly before implementing IMEX.

If IMEX is to be a worthy replacement of the existing systems it must be possible to run the client on a number of different interfaces. Although V-COMs are most suited, the IMEX must support desktop computers and handheld devices as well. The challenges here should be studied further.

6. Conclusion

In this master thesis we have analyzed the daily operation at the operation center of one of Sense Intellifield's customers using the method of Contextual Design. Some of the results that were found using Contextual Design have been used for design of a prototype with guidelines and ideas for Sense Intellifield's Integrated Media EXchange project.

Contextual Design proved strong for user analysis. It required some time to get familiar and comfortable with the method, but once this period is over it worked very well, and the more experience one gets, the better it works.

The contextual inquiry part where we got to know the users and their routines was easier because of the master / apprentice model. The users felt that their opinion was valuable, and the use of models as simple sketches on paper made it easier to get them involved.

Contextual Design provides few guidelines when it comes to the actual prototyping,

Our prototype design was not to be limited by existing technology, and the fact that we come up with ideas on how the "ideal" system should work, and not what was technically possible, seemed to inspire developers to think in new ways. This is a much more offensive way of software design, than to start off by looking at what can be done with available technology.

The iteration of prototypes proved important to get users and designers involved from the beginning. For experienced test users at Sense Intellifield, the first simple version with no functionality was enough to get a discussion going. This led to important feedback that prevented work to go in the wrong direction and saved time.

The last prototype was tested with users at ConocoPhillips and was very well received. The simplicity was appreciated and the users understood all submenus with little or no guidance. The "drag and drop" feature was mentioned as very user friendly.

Although options like video conferencing and chat were new to the users, they immediately expressed satisfaction with the enhanced CCTV capabilities and more local changes like the ability to adjust the room temperature.

Because of the rapid change in personnel at different locations in the oil industry, it is important that the IMEX application is very user friendly. This is achieved through a tidy, recognizable user interface. Operators that have been using the V-Com desks will have an easy transition to the new system, because of the interface similarity with the existing touchpad interface.

Easy communication and collaboration is essential in the leading industry corporations of tomorrow, and the IMEX concept could be deployed with success in other branches than the oil industry.

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